FOUNDRY TRADE JOURNAL

EST. 1902

VOL. 107 WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL
No. 2243 DECEMBER 3, 1959
Registered at the G.P.O. as a Newspaper Offices: John Adam House, John Adam St., London, W.C.2

Single Copy, 1/- By Post 1/4. Annual Subscription, Home 52/-, Abroad 60/- (Prepaid)

The most successful

economical

and widely used

MOULDING BOX

in the world

THE UNIVERSITY OF MICHIGAN
DEC 22 1959
ENGINEERING LIBRARY

over 60 standard styles and sizes | write for catalogue

Sterling

found in 9000 foundries

STERLING FOUNDRY SPECIALTIES LTD. BEDFORD · ENGLAND

Cogent

BIGGER VALUE

AND MORE COMPACT DIMENSIONS IN THE IMPROVED LH-I LOADER

LH-I Loader

Numerous improvements now incorporated as standard, add up to better value than ever in the Muir-Hill LH-1 diesel hydraulic loader. Used in countless jobs in works, factories, and ships' holds, users say they don't know how they managed without it.

If you have a bulk material handling problem in a confined space, it could mean the same to you.

LET US SEND YOU THE LITERATURE.

dm EB850

Muir-Hill Regd.

BUILT BY BOYDELL

E. BOYDELL & CO. LTD · UNIVERSAL WORKS · OLD TRAFFORD · MANCHESTER 16

FOUNDRY TRADE JOURNAL

Vol. 107. December 3, 1959 No. 2243

Established 1902

Incorporating

IRON & STEEL TRADES JOURNAL

Single copy 1s.; *by post* 1s. 4d. *Annual subscription: home* 52s. *abroad* 60s. (*prepaid*)

Editor:
V. C. FAULKNER, F.R.S.A., HON.M.I.B.F.

Assistant Editor: A. R. PARKES, M.I.B.F.
Commercial Editor: P. E. CARDEN.

Advertising Manager:
F. BARRINGTON HOOPER, B.A.

Production Manager:
R. J. LOVELL

Publisher: H. J. DWYER
Circulation Manager: E. T. GRIFFITHS

District Representatives:
G. P. ELLIOTT (Northern Area) 'phone: Altrincham 1334
T. H. SMITH (Scotland) 'phone: Dumbarton 1946
D. C. RYALL (Southern Area) 'phone: TRAfalgar 6171

The FOUNDRY TRADE JOURNAL is the official organ of the British Steel Founders' Association; Association of Bronze & Brass Founders; the Light Metal Founders Association; Foundry Trades' Equipment & Supplies Association; and the National Society of Master Patternmakers.

AN INDUSTRIAL NEWSPAPERS PUBLICATION

Published Every Thursday by Industrial Newspapers, Limited

BARRINGTON HOOPER, C.B.E., *Chairman and Joint Managing Director*
F. BARRINGTON HOOPER, B.A., *Joint Managing Director and Commercial Director*
F. R. LEWIS, JOHN HOOPER, D. HORN *Directors*
E. G. WESTON, *Director and Secretary*

JOHN ADAM HOUSE, 17-19, JOHN ADAM STREET, ADELPHI, LONDON, W.C.2

Telephone: Trafalgar 6171 (*Private Branch Exchange*)
Telegraphic Address: "Zacatecas, Rand, London"

PRINCIPAL CONTENTS

PAGE

F. H. Lloyd's Radiography Unit

Description of what is believed to be the largest gamma-ray unit ever installed for the examination of steel castings 541

British Cast Iron Research Association

Extracts from the Association's annual report for the year ending June 30 545

Atmospheric Dust in Investment Foundries

By C. M. Stoch, Dip. Ing., F.I.M.

Paper based on research carried out by the British Steel Castings Research Association into the problem of dust in foundry atmospheres 553

Process Control in the Investment Shop

By J. Mitton

The large degree of control which is essential for the efficient operation of an investment shop is described, each department of the shop being dealt with individually. Many of the precepts enunciated have equal applicability in other types of foundries 560

Appareillage radiographique chez F. H. Lloyd.
Description de ce qui est sans doute le plus grand appareillage de rayons gamma installé jusqu'à ce jour pour l'examen de pièces coulées en acier. 541

British Cast Iron Research Association.
Extraits du rapport annuel de l'Association sur l'année finissant le 30 Juin. 545

Pousséire dans l'Atmosphère des Fonderies à la Cire perdue. Par C. M. Stoch, Dipl.Ing., F.I.M.
Article basé sur une étude effectuée par la British Steel Castings Research Association, concernant le problème de la poussière de silice dans l'atmosphère des fonderies. 553

Procédé de Contrôle dans un Atelier de Moulages à la Cire perdue. Par J. Mitton.
L'important degré de contrôle qui est nécessaire pour le bon rendement d'un atelier de moulages à la cire perdue est étudié, chaque partie de l'atelier étant traité séparément. 560

Die Radiographie-Anlage der Firma F. H. Lloyd.
Eine Beschreibung der vermutlich grössten jemals errichteten Gammastrahlenanlage zur Prüfung von Stahlguss. 541

British Cast Iron Research Association.
Auszüge aus dem Jahresbericht des englischen Gusseisenforschungsinstitutes für das am 30 Juni abgelaufene Jahr. 545

Der Staubgehalt der Luft in Feingiessereien. Von C. M. Stoch, Dipl.Ing., F.I.M.
Ein auf Untersuchungen, welche von der British Steel Castings Research Association durchgeführt wurden, gegründeter Vortrag, der sich mit der Frage des Kieselerdestaubes in Giessereiatmosphären befasst. 553

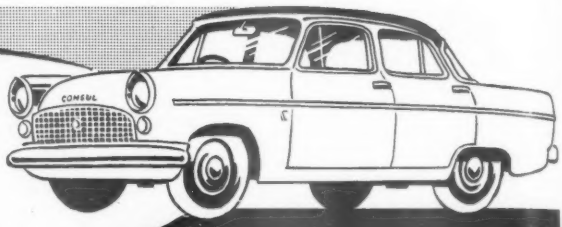
Verfahrenskontrolle im Wachsausschmelzbetrieb. Von J. Mitton.
Es werden die umfangreichen, für die erfolgreiche Leitung eines Wachsausschmelzbetriebes nötigen Kontrollmassnahmen beschrieben, wobei jede Abteilung des Betriebes einzeln behandelt wird. 560

Features, News, Commercial Information and Statistics

Leader: Trade Conditions 539
Forthcoming Events 540
American Letter 543
Equipment and Supplies 544
Prizegiving at Stanton 565
Latest Foundry Statistics 566
Raw Material Markets 567
Current Prices of Iron, Steel and Non-ferrous Metals 568
AEI Reorganization 570
Duties reduced on Import Machine Tools 570
Export Opportunities 570
ECGD Cover for Confirming Houses 570
Notes from the Branches 571
News in Brief 572
Personal 574
Company News 576

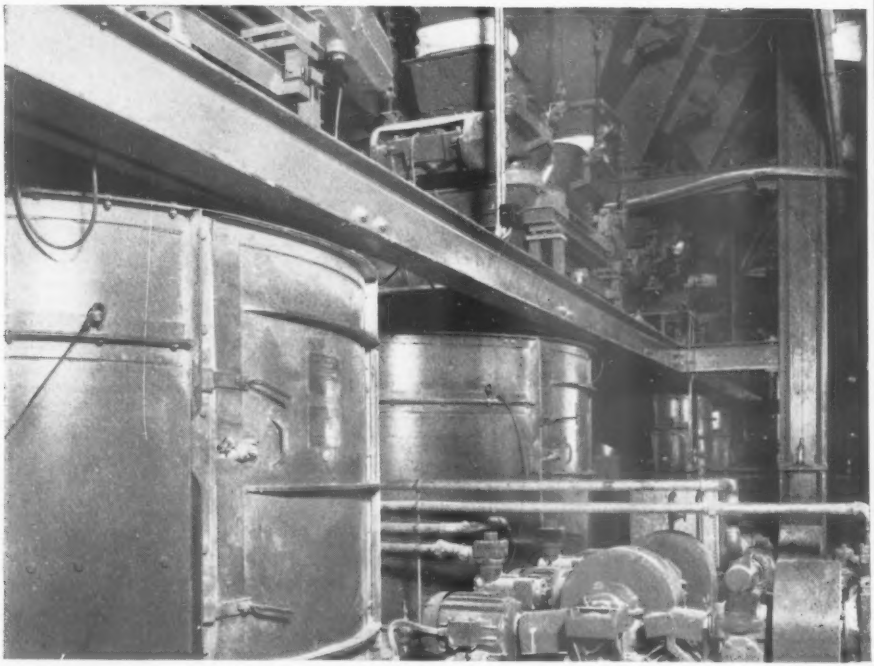
At work in the

FORD FOUNDRY....



AUGUST-SIMPSON *Mix-Mullers*

An impressive batch of four August-Simpson Mix-Mullers for Core Sand Mixing Plant—Large size 2F—each Mix-Muller having a batch capacity of 2,000 lbs. Each Mix-Muller is charged by means of an overhead batch hopper in conjunction with an automatic weighing plant. The charging operation and sequence for material and liquid additions, length of mixing cycle, and discharge mechanism are automatically controlled.



Photograph by courtesy of THE FORD MOTOR CO. LTD.

Sole Licensees and Manufacturers for the British Empire (excluding Canada, Australia and New Zealand) of the Simpson Sand Mixer.

AUGUST'S LIMITED · HALIFAX · ENGLAND

Telephone: Halifax 61245/6/7/8 **Telegrams: August, Halifax**

FOUNDRY
TRADE JOURNAL
Vol. 107 DECEMBER 3, 1959 No. 2243

Trade Conditions

In most areas of Great Britain, trade conditions are rapidly approaching a boom, and in this context it is germane to examine the cause of the change from the quite recent recession. According to Mr. Anthony Tuke, the chairman of Barclays Bank, improving trade conditions had their birth at the beginning of 1957 with a decrease in the price of raw materials in the year of about 15 per cent. This materially assisted our export potential, and though to-day the decrease is of the order of 10 per cent, it is still a favourable factor. As the ironfounding industry—by and large relying as it does on home-produced raw materials—enjoyed no such benefits, it never possessed any great margin of profits to pass on to the consumer. This reliance on home-produced raw materials may in some measure account for the existence of a level of profit lower than the general average of industry.

Government propaganda, in line with the Cohen Committee recommendations, is being directed towards the reduction of retail prices. This for the man in the street is sound sense, as there is no income tax to be paid on the money so saved, and moreover, the action is anti-inflationary. Acting in this direction also is a reduction in income tax, whilst conversely, increase in the general level of wages is inflationary. The foundry industry, however, does buy a large variety of goods and any help by way of reduced prices would be useful, not merely for the paying of higher dividends, but to swell the reserves, for most concerns are anxious to re-equip sections of their plant in order to manufacture more cheaply. Increased competition in many sections of the foundry industry can be anticipated in coming years, resulting from all the various proposals to reduce and finally eliminate tariffs.

The current position of industry needs much vigilance, for already we hear of impending shortages and, indeed, it is possible to visualize difficulties in the supply of castings for the machine-tool trade, as the order books are reported to be filling up extremely rapidly. A large number of ironfoundries have ceased to function, and as a result of the consequent reduction in capacity of the industry in certain directions, some producers are likely to be overtaxed in the near future, despite the inroads made by welded structures. The coming demands must be met intelligently and quickly otherwise more business will be permanently lost to the foundry industry.

Forthcoming Events

DECEMBER 7

Institute of British Foundrymen

Sheffield branch: "Measurement and Control of Dust in Foundries," by A. H. Sully, C. M. Stoch, and J. M. Slater, 7 p.m., at the College of Commerce and Technology, Pond Street.

Lancashire branch: "Patternmaking for Jobbing and Mechanized Foundries," by H. Blackburn, 7 p.m., at the Midland Hotel, Manchester.

DECEMBER 8

Institution of Production Engineers

Halifax and Huddersfield section: "Epoxy-resin Tooling," by E. M. White, 7.30 p.m., at the Percival Whitley College of Further Education, Francis Street, Halifax.

Institute of British Foundrymen

Coventry section: "Review of the First Five Years' use of the CO_2 Process in British Foundries," by A. Tipper, 7.30 p.m., at the Coventry Technical College, Room A5.

Institute of Fuel

"Waste Gas Corrosion," by Dr. G. Whittingham, 6.30 p.m., at the Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham 2. (Joint meeting with the North Staffs Fuel Society.)

Institution of Plant Engineers

Leicester branch: "Different Aspects of Lubrication," by P. Spray, 7.30 p.m., at the Grand Hotel. (Joint meeting with the Institution of Works Managers.)

Birmingham branch: "Safe Use of Electricity in Factories," by G. L. Leighton, 7.30 p.m., at the Hotel Leofric, Coventry.

DECEMBER 9

Institute of British Foundrymen

Birmingham branch: "Problems in the Calculation of Feeding-head Dimensions," by N. Snelson, 7.15 p.m., in the Lecture Hall, Byng Kenrick Suite, College of Technology, Gosta Green.

Combustion Engineering Association

Northern region: Discussion on the Clean Air Act, 2.30 p.m., at the Great Northern Hotel, Leeds.

Institute of Fuel

Yorkshire section: Discussion on the "Implementation of the Clean Air Act," 2.30 p.m., at the Metropole Hotel, Leeds.

North-western section: "Brains Trust" or "Any Questions," 6.30 p.m., at the Engineers' Club, Albert Square, Manchester. (Joint meeting with the National Society for Clean Air.)

Institution of Plant Engineers

Dundee branch: "Construction of Modern Factories with reference to Buildings at the Dundee Industrial Estate," by J. Watson Ritchie, 7.30 p.m., at the Taypark Hotel, West Ferry.

East Midlands branch: "Education and Technology in Russia," by I. G. Slater, 7 p.m., in the Sherwood Room, County Hotel, Theatre Square, Nottingham.

Western branch: "Hydraulics," by E. J. Pegler, 7.15 p.m., at the Grand Hotel, Broad Street, Bristol.

DECEMBER 10

Institution of Production Engineers

"Production Engineering Developments in Russia" (Sir Alfred Herbert Paper), by Dr. D. F. Galloway, 6.30 p.m., at the Royal Institution, Albemarle Street, London, W.1. (Admission by ticket only.)

Wolverhampton graduate section: Works visit to Quasi-Arc, Limited, Bilston, Staffs, commencing 2.30 p.m.

Institution of Plant Engineers

North-east branch: "Hydraulics," by F. H. Towler, 7 p.m., at Roadway House, Oxford Street, Newcastle-upon-Tyne.

Merseyside and North Wales branch: "Electrical Regulators," by D. A. Picken, 7.15 p.m., at "The Blossoms," Chester.

Institute of Metals

Birmingham local section: "Hot-dip Galvanizing," by M. L. Hughes, 6.30 p.m., at the College of Technology, Gosta Green.

East Midlands Metallurgical Society

"Vacuum Metallurgy," 7.30 p.m., at the School of Art, Green Lane, Derby.

Institute of British Foundrymen

Stoke-on-Trent section: "Some Practical Experiences in making Moulds in a Mechanized Foundry," by H. Pinchin, 7.30 p.m., in the Stipendiary Court Room, Hanley Town Hall.

Beds & Herts section: "CO_2 Process," by T. C. Wilson, 7.30 p.m., at K. & L. Steelfounders and Engineers, Limited, Letchworth. (Liaison meeting with London branch.)

Southampton Metallurgical Society

"Corrosion and Microstructure," by Dr. Edeleanu, 7.15 p.m., in the Engineering Block, Southampton University.

DECEMBER 11

Institute of British Foundrymen

Bristol and West of England branch: "Some Experiences in the Production of Copper-base Alloys," by G. W. Brown and C. B. Searles, 7.30 p.m., at the Royal Hotel, Bristol.

DECEMBER 12

Institute of British Foundrymen

Newcastle and district branch: Meeting at 6 p.m. in the Neville Hall, Westgate Road, Newcastle-upon-Tyne. (Details from the secretary.)

Scottish branch: "Mechanical Aids to Shell Moulding," by D. H. Scott, 3 p.m., at the Royal College of Science and Technology, George Street, Glasgow.

Institute of Metals

Council Elections

The Institute of Metals announces that the following members have been elected to fill vacancies on the Council with effect from the annual general meeting on March 29, 1960. *As president*, Sir Ronald Prain, O.B.E., HON.M.I.M.M., chairman and president, Rhodesian Selection Trust, Limited; as *vice-presidents*, Dr. H. M. Finniston, B.SC., A.R.T.C., F.I.M., research manager, C. A. Parsons & Sons, Limited, and Mr. H. W. Hignett, B.SC.(ENG.), F.R.I.C., F.I.M., assistant managing director, Henry Wiggin & Company, Limited, and as *ordinary members of Council*, Dr. R. W. K. Honeycombe, M.SC., Professor of Physical Metallurgy, University of Sheffield; Dr. Ivor Jenkins, F.I.M., chief metallurgist, research laboratories, General Electric Company, Limited; Mr. E. Robson, managing director, Manganese Bronze & Brass Company, Limited; Mr. J. Salter, B.SC.(TECH.), A.M.I.E.E., director, British Aluminium Company, Limited, and Mr. Christopher Smith, F.I.M., works director, James Booth & Company, Limited.

Forty Years Ago

In the December, 1919, issue of the JOURNAL, the Editor made a strong appeal for the creation of a research association, and noted with interest that founders in the Falkirk district were discussing the creation of a regional laboratory. In this issue the first mention was made of a sand-throwing moulding machine invented by Beardsley and Piper. A large number of new companies was listed and of these the following are amongst the survivors:—Dewhurst and Partner, Limited; Hilbrooks Foundry, Limited; Goodwin Barsby, Limited; Valbanca, Limited; Brassfounders (Sheffield), Limited; John Dewhurst, Limited; Lane and Girvan, Limited, and Atlas Diesel, Limited.

Mr. W. T. NEILL has been appointed managing director of Platt Brothers & Company, Limited, textile-machinery manufacturers, Oldham, Lancashire. Mr. Neill is an associate member of the Institution of Production Engineers and a fellow of the Royal Aeronautical Society. He was awarded the M.B.E. for services to the aircraft industry.

F. H. Lloyd's Radiography Unit

World's Largest Gamma-ray Source for Castings Examination?

In order to meet increasing demand for radiographic inspection, what is believed to be the largest gamma-ray unit ever installed for the examination of steel castings has been set up at the Wednesbury steel foundry of F. H. Lloyd & Company, Limited. A description of the apparatus and its ancillary equipment is given in the following article.

F. H. Lloyd & Company, Limited, of Wednesbury, have recently installed a large gamma-ray source in their steelfoundry, for the examination of castings. This remote-controlled unit (Fig. 1) containing 20 curies of cobalt 60, weighs 12 cwt. and is universally mounted to cover all angles of inspection. The unit is basically comprised of two spheres of lead—the storage sphere which houses the source when not in use and the exposure sphere which incorporates a window in the form of a 60 deg. conical aperture.

Two 10-curie Sources

The system, which was installed in June 1958 and which has now been well proved in constant use, houses two 6 by 6 mm. sources of 10 curies each. These are arranged one behind the other, thus maintaining an effective radiation area of 6 by 6 mm. at the cost of only a small loss in speed, due to attenuation within the front source. The unit is suspended from a jib hoist (Fig. 3) giving a maximum height of 11 ft. over a radius of 12 ft. The jib may be turned through an angle of 210 deg. to cover a good area of the exposure room. Transfer of the source from the closed position to the exposed position is effected electrically from the control panel illustrated in Fig. 2. Control of the source is also effected from this panel, which is situated outside the exposure area and exposure times may be pre-set up to a maximum of 24 hours by means of process timers. The panel includes a lock to ensure that the unit cannot be operated by an unauthorized person, and interlocks are provided at the two points of access to the exposure room.

Exposure Room

Such a large source, even though it is directional in action, necessitates considerable protective measures. The exposure room, situated in an area somewhat remote from the foundry shops, measures

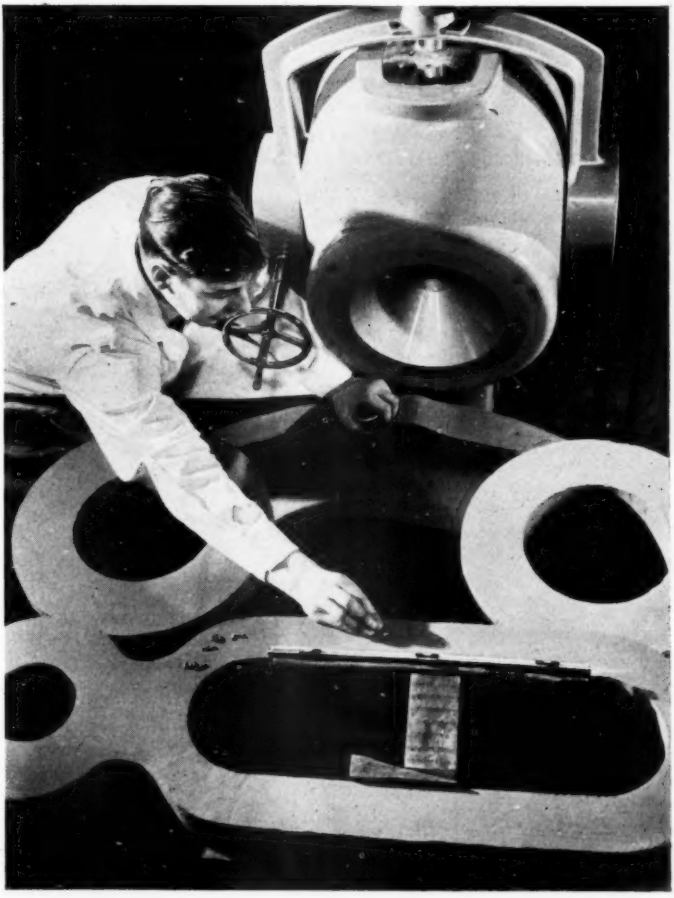
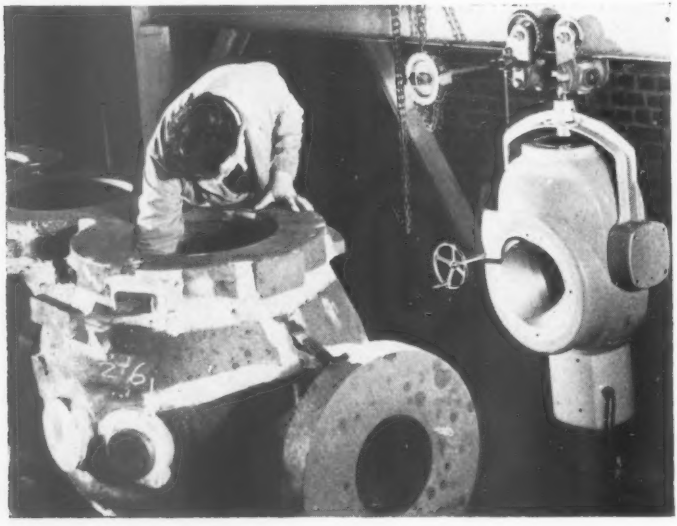


FIG. 1.—*Setting up the 20-curie radiographic unit on a Lloyd's steel casting. The film to be exposed is located behind the flange in the foreground; the casting being a marine-turbine casing. (This casting is, in fact, the main driving cylinder of a frigate turbine.)*

FIG. 2.—*Operating the remote-control panel for the radiographic unit. Exposures can be set for up to 24 hr. Audible and visible warnings are given at the end of each exposure.*

FIG. 4.—(*right*) *Setting the unit for examining an automatic-coupler casting. The sensitized film is placed under the base flange. Exposure is 10 min. at 36 in. using Ilford CX fine-grain film.*

FIG. 3.—*Radiography of large valve castings; note the traversing mechanism for the unit carried on the beam of a jib crane. The casting in this photograph is set up on a 15-ton trailer.*



internally 48 by 26 ft. and is constructed of brick wall 27-in. thick. The main door, which weighs 9 tons, is of concrete 15-in. thick and its movement is motorized. An outer wall around the building maintains the area in front of this door clear for a further 30 ft.

Background

F. H. Lloyd & Company, Limited, first introduced radiographic inspection methods in 1946 with the objective of assisting in the production of better

and cheaper steel castings. Many customers quickly realized that these facilities were available for proving the internal soundness of castings, and since that time there has been an increasing demand for radiographically-inspected castings. To-day, in addition to an expanding domestic service, the radiographic requirements of customers and the major inspecting authorities are being met. Castings ranging in weight from a few pounds to 20 tons, and sectional thicknesses from half an inch to eight in. are regularly examined (see Fig. 4).

Other Sources

In addition to the cobalt source mentioned earlier, radiographic inspection is carried out with gamma-rays produced from other radioactive materials—iridium for sections up to

1¼ in. (the cobalt source for sections up to 8-in.), and radio-active caesium is being introduced for the thickness range of ½ to 3 in. which is very frequently encountered. By using advanced techniques, a two-per cent. penetrameter sensitivity over the whole section range has been achieved. The large unit has substantially reduced exposure times and the department is now in a position to examine a much larger tonnage of castings. (The following are typical exposure times with the 20-curie unit: 2-in. steel section, 4 min.; 4-in. section, 20 min.; 6-in. section, 2 hr., and 8-in. section 16 hr. exposure (overnight)).

American Letter

New Plastic Pattern Material*

Pattern cost influences casting cost considerably, so most foundrymen like to have patterns that are low in cost and high in life expectancy. This is an account of the author's efforts to find (*a*) a better method of repairing patterns, and (*b*) a really long-lasting material.

Repair

Conventional repair materials, such as plastic wood and epoxy putties, and repair by brazing, welding and soldering, were found to leave much to be desired. Eventually, a new rubber-like plastic material was tried, with great success. Using this, a hardener powder is mixed with a quick-curing plastic compound and spread on the repair area. Depending on the amount of hardener powder used, the material sets in 5 to 10 min., and does a hard, dense repair job. After hardening, the material may be sanded, milled, drilled, tapped, filled or chiselled without injury to, or dulling of, the tools employed. The finish obtained will take conventional pattern coatings such as shellac or lacquer, and can also be used effectively without a coating. It is inexpensive, speedy to use, has good wearing characteristics and gives a substantial reduction in repair time.

Long Life

A review of conventional pattern materials which was made indicated that some materials were more abrasion resistant than others, but all fell short of requirements as regards really long life. Finally, however, the material mentioned above was selected as being the best available. Its physical properties are

TABLE 1.—*Physical and Chemical Properties of Solid Plastic-rubber Elastomers.*

Abrasion resistance	Exceptional
Tensile strength (tons per sq. in.)	1·8 to 2·9
Elongation (per cent.)	400 to 600
Tear strength (tons per sq. in.)	0·13 to 0·33
Compression modulus at 10 per cent. deflection (tons per sq. in.)	0·04 to 0·44
Hardness, shore A	60 to 98
Modulus of elasticity (tons per sq. in.) at 300 per cent.	0·27 to 1·34
Compression set resistance	Good to outstanding
Heat resistance to 121 deg. C.	Continuous duty
to 177 deg. C.	Intermittent duty
Specific gravity	1·24

given in Table 1. The material's resistance to kerosene and fuel oils is excellent. Acids, alkalis, methylene chloride, benzine, carbon-tetrachloride, toluene and alcohol will either destroy the material or cause severe swelling. Although water absorption is almost negligible, there is a possibility of slight swelling in water or in humid atmospheres. Tests on this plastic rubber proved that it lasts longer than cast-iron or steel when exposed to abrasion, impact, etc.

Disadvantages

One of the problems encountered was the adhesive binding of plastic rubber to metal. A suitable adhesive has now been developed which is economical and simple to use. The main disadvantage is that some of the materials used in producing the rubber are volatile, and can produce allergies or asthmatic conditions in persons working on its production who are sensitive to these materials. Some of the materials are also skin irritants, and upon the respiratory system and mucous membranes. Extreme care must be exercised in handling them at all times. However, this hazard can be reduced by adequate ventilation of work places. The production of this new material involves heat, vacuum, precise proportioning, close time-limits and extremely fast handling when the batch is ready. Wrong mould temperature, excessive amounts of release agent, and changes in relative humidity have a deleterious effect on the quality of the end product. While these problems may seem somewhat insurmountable at times, work now being done on simplification of the process holds great promise for the future. Tests have been sufficiently successful to indicate that plastic rubber has a definite future as a pattern material, and that reductions in repair and maintenance costs may be achieved by its use.

*A topic discussed at the 1959 Congress of the American Foundrymen's Society; the Author, Mr. J. Edward Olson, is special applications engineer, Dike-O-Seal, Chicago.

Ohio Regional Foundry Conference

The Deshler-Hilton Hotel, Columbus, Ohio, was the scene this year of the Ohio Regional conference, on October 22 and 23. Included in the programme were the following papers: "CO_2 Process in the Foundry," panel discussion, chairman, E. H. King (Hill and Griffiths Company); "Electric Furnace Practice," by J. Hathaway (Massillon Steel Castings Company, Ohio); "Water-cooled Cupolas," by M. H. Horton (Deere & Company, Moline, Ill.); "Melting Brass by Induction, Indirect-arc and Crucible Methods," by A. W. Bardeen and W. J. Amsbary (Ohio Brass Company, Mansfield); "Hot-tears in Steel Castings," by J. A. Rassenfoss (American Steel Foundries, East Chicago, Ill.); "Inoculation—Control Tool for Acid and Basic Cupola Melting," by A. P. Alexander (International Harvester Company, Memphis, Tenn.); "Gating and Risering Copper-base Alloys," by W. Ball, senr. (R. Lavin & Sons, Chicago); "Metallurgy of Cast Steel," by C. K. Donoho (American Cast Iron Company, Birmingham, Alla.); "Manufacturing Procedure and Economics using Cold-set Oil Bond," by G. Johnstone, jnr. (Johnstone Foundries, Inc.); "Metallurgy of Aluminium and Magnesium," by E. E. Stonebrook, Aluminium Company of America, Cleveland); "Sand," by G. Vingus (Magnet Cove Barium Corporation); "Risering of Grey Iron and S.-g. Iron," by J. F. Wallace (Case Institute of Technology); "Solidification and Feeding of Malleable Iron," by B. C. Yearley (National Malleable and Steel Castings Company, Cleveland), and "Permanent-moulding Aluminium Alloys," by R. Petto, jnr., and R. Seher (Arrow Aluminium Castings Company, Cleveland).

A WORTH-WHILE REDUCTION in the price of their Chieftain truck chassis has been made by Albion Motors, Limited, Glasgow. The new Chieftain series II range of seven-ton truck chassis will now be marketed in Britain at some £50 below the price of previous models.

Equipment & Supplies

Vacuum Treatment of Molten Metals

Birlec-Efco (Melting), Limited, Tyburn Road, Birmingham, 24, are now marketing a de-gassing, and vacuum-refining unit (see Fig. 1) which, though claimed to be relatively inexpensive gives close control over temperature and pressure. Turbulence of the metal in the vacuum vessel is induced electromagnetically, and therefore cycle times are reasonably short, it is stated. A unit of this type has recently been installed at the Birmingham Works of Henry Wiggin & Company, Limited, for the vacuum refining of special alloys. Basically, it is a 15-cwt. mains-frequency induction-melting furnace housed in a tiltable vacuum-tank. A water-cooled copper induction-coil, which is supported by a magnetically-shielded steel framework, forms the furnace proper. It is claimed that careful design has ensured that no troubles will arise through electrical breakdowns within the furnace. Mains frequency was chosen not only because of the lower cost of the mains-frequency electrical gear when compared with high-frequency equipment, but also for the inherently greater degree of turbulence which a mains-frequency furnace imparts to molten metal. The present installation has a rating of 300 kw, and is arranged for connection to a low-tension three-phase supply. The vacuum tank, which houses the furnace, is mounted on trunnions and tilted by twin hydraulic cylinders. Hydraulic controls open and close the vacuum-tank lid and pneumatic clamps lock the lid on to the tank. The furnace mouth carries a refractory cover which reduces heat losses and cuts down the loss of metal by splashing. The vacuum-pumping lines are connected to the tank concentrically with the tilting trunnion, so that pumping connections are not demounted when the furnace tilts. The whole equipment has been designed for use by relatively unskilled personnel with a minimum of technical supervision.

Furnace Operation

A typical vacuum-refining cycle occupies about one hour, liquid metal being brought to the furnace by ladle. After charging and sealing, the chamber pressure is then reduced to about 200-300 microns in about 15 min. During refining sufficient power is applied to the furnace to ensure thorough stirring of the molten metal, and to maintain temperature at the desired value. After vacuum treatment, air is admitted back into the furnace, the hydraulic gear raises the lid and the retractable spout is placed in position. The temperature of the metal is adjusted and checked by dip thermocouple, after which the furnace tilts, pouring the vacuum-refined metal into a ladle for casting or teeming in the conventional way.

Results

High-temperature properties obtained so far on vacuum-refined metals have proved very satisfactory. A standard basic refractory lining is in use, rammed around a normal type of former. As the actual cost is said to be only a few pence per pound of metal treated, it is claimed that the mains-frequency degassing and vacuum-refining furnace can bring practically all the benefits of vacuum-melting into the foundry and melting shop at quite low capital and operating cost.

Furnaces for Enamel Fusing

The development of the Jetube radiant-heating element for use in vitreous-enamel fusing furnaces was referred to in a paper to the Scottish section of the Institute of Vitreous Enamellers in February, 1958. This aroused considerable interest, and since that time two prototype furnaces using specially designed Jetubes have been built and tested by the development division of Incandescent Heat Company, Limited (Cornwall Road, Smethwick, Birmingham). The first batch-type furnace using this system has now been built for an important vitreous-enamelling works, and will be in service shortly. A continuous split-crown type of furnace, also heated by Jetubes, has just been commissioned at the works of Smart & Brown, Limited, Spennymoor, Co. Durham. It is claimed that the Jetube radiant element (which may be gas- or oil-fired) gives an amazing flexibility of operation, and allows the use of a highly-insulated furnace structure with low thermal-storage; consequently fuel consumption is low, and output is increased. Jetubes have already been used in industry as heating elements in batch and continuous furnaces for carburizing, hardening, annealing and stress-relieving.

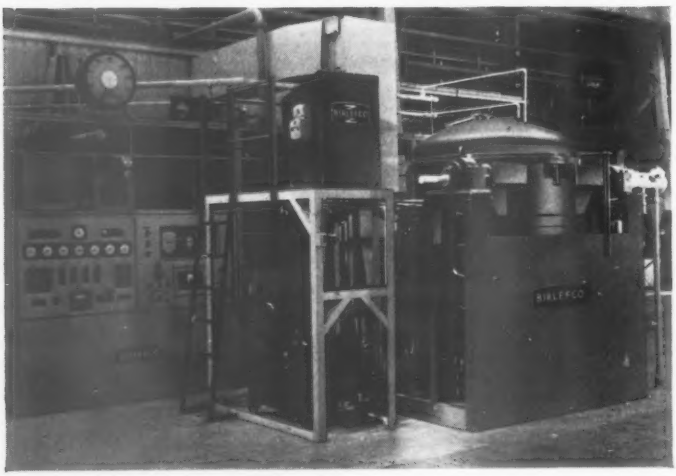


FIG. 1.—*De-gassing and vacuum-refining unit now being marketed by Birlec-Efco (Melting), Limited, of Birmingham. A water-cooled copper induction-coil, supported by a magnetically-shielded framework, forms the furnace proper.*

Dickow-Pumpen Centrifugal Pumps: Firth Cleveland Pumps, Limited, Stornoway House, Cleveland Row, London, S.W.1, are to manufacture under licence the range of self-priming multi-stage centrifugal pumps designed and developed by Dickow-Pumpen, of Wailkrayburg, near Munich, in Western Germany. The British company will be able to sell the pumps in all parts of the world, with the exception of the Common Market countries, Scandinavia and India.

British Cast Iron Research Association

Report on Activities during the Year ending June 30, 1959

This year's report of the British Cast Iron Research Association deals first with general subjects, such as elections to the Council and committees, finance, personalia and the "open days" at Alvechurch. The main part of the Report then describes *in extenso* the various research projects which are in hand, amongst which are investigations on the variation in degree of nucleation of grey iron, an extensive programme to obtain data on the maximum safe working temperature for cast-iron and other work.

The annual general meeting of the British Cast Iron Research Association was held on November 3 at the Connaught Rooms, London, when the following report covering the year's activities to June 30 was presented:—

At the annual general meeting of the Association, held in London on November 4, 1958, Mr. E. Player, C.B.E., was re-elected president of the Association for a further year, and the following were elected members of Council and vice-presidents: Sir William Scott, O.B.E., J.P., M.I.MECH.E., Sir Henry Spurrier, M.I.M.E., and Mr. C. R. Wheeler, C.B.E. Mr. A. E. Peace was re-elected a member of Council and vice-president.

General

During the year the Council held six meetings, and 13 meetings were held by the advisory committee. Mr. H. J. V. Williams was re-elected chairman of Council for 1959 and Mr. M. M. Hallett, M.SC., F.I.M., was re-elected vice-chairman; Mr. S. H. Russell, O.B.E., C.G.I.A., was re-elected honorary treasurer. The main committees of the Council held 16 meetings. Mr. P. A. Russell, B.SC., F.I.M., Mr. G. R. Buckley, Mr. R. L. Handley, B.SC.(TECH.), A.M.I.E.E., Mr. W. Brindley, and Mr. R. Taylor continued as chairmen of the research board, development committee, information committee, foundry atmospheres committee and Scottish committee respectively. The operational research team committee was reconstituted as the foundry operations committee under the chairmanship of Mr. A. E. Pearce.

Eighteen meetings were held by the sub-committees and panels of the main committees of Council, making a total of 53 meetings during the year. The Association is much indebted to its Council, committee and sub-committee members for their services.

During the year the Council was strengthened by the election of Mr. W. Brindley in November, 1958, and more recently by the appointment of Mr. H. A. Redshaw in July, 1959. The Council accepted with regret the resignations of Mr. J. F. Stanier and Mr. A. Wynn. It was with great regret that the Council in June, 1959, learned of the death of Dr. J. E. Hurst, C.B.E., J.P., a member of Council since 1925, and president of the Association from 1950 to 1952, and also in the same month, of the death of the Right Hon. the Viscount Weir of Eastwood, P.C., G.C.B., D.SC., LL.D., the first president of the Association from 1921 to 1924.

In June, 1959, the Council noted with pleasure the award of the O.B.E. in the Birthday Honours List to Mr. S. H. Russell, C.G.I.A., the honorary treasurer, and a past-president of the Association. In November, 1958, the Founders' Medal was awarded by the Worshipful Company of Founders to Dr. J. G. Pearce, C.B.E., for services to the art and mystery of founding, with special reference to the Fellowships of the Worshipful Company. In December, 1958, the Council welcomed the appointment of Mr. A. E. Pearce as a part-time member of the Iron and Steel Board. The Council is pleased to be able to report that although Sir Frederick Scopes, M.A., has relinquished his office of managing director of the Stanton Ironworks Company, Limited, he continues to serve on the Council and advisory committee.

The income and expenditure account for the year ended June 30, 1959, and the balance sheet as at June 30, 1959, accompanied the report. Income at £196,888 is £3,433 less than the preceding year, but the previous year received the credit of an exceptional item of £5,000 for Patent assignments. Grant-earning income again exceeded £120,000, enabling the Association to earn the maximum Government grant of £56,000. The Association is indebted to the Joint Iron Council for subscribing the major part of grant-earning income, £114,386.

Finance

Revenue expenditure has risen from the previous year's figure of £175,449 to £190,527. The increase reflects the additional facilities provided by the Association for member-firms, and increased depreciation charges resulting from the completion of the foundry-atmospheres block and cupola installation. The excess of income over expenditure for the year is £6,361, and of this amount £5,000 has been transferred to the buildings and equipment fund, the balance of £1,361 being added to the general fund. The balance sheet shows that the net value of fixed assets now stands at £222,911, and current assets at £132,346 show an excess over current liabilities of £124,754. The buildings and equipment fund now stands at £252,500, and the general fund at £12,228. Capital expenditure during the year amounted to £75,642. Commitments in respect of outstanding orders for capital items at June 30, 1959, had been reduced to £12,228.

During the year the main problem facing the Council and advisory committee has been that of

British Cast Iron Research Association

finance. Reference was made in the last Report to the need for additional funds to enable activity to continue at the current level and to provide for the first stage of the new laboratory block. The year ended June 30, 1959, was the last in the current quinquennium for Government grant, and towards the end of 1958 and early in 1959 a comprehensive memorandum was prepared, setting out the Association's case for Government grant for the next five-year period commencing July 1, 1959. The Association is much indebted to the Joint Iron Council for the considerable assistance given in the preparation of this memorandum. The Association's representatives, led by Sir Frederick Scopes, met the Industrial Grants Committee on March 19, 1959, and the Association was subsequently informed of the new terms of grant. For an industrial income of £135,000, it was announced that the Government would make a block grant of £50,000. For every additional £ of industrial income above £135,000, the Government would make a supplementary grant of 15s., subject to a maximum supplementary grant of £24,000. The terms for the preceding five-year period were that for industrial income of £100,000, a block grant of £40,000 was paid, and for every additional £ of grant-earning income above £100,000, a supplementary grant of 16s. was paid, subject to a maximum supplementary grant of £16,000.

Although the terms of grant are now more severe, an encouraging feature is the opportunity of earning £18,000 more Government grant than was possible under the old terms. The Council decided that these terms should be accepted by the Association.

Need for Additional Industrial Income

The need to raise additional industrial income to earn the block Government grant emphasized to the Council the need for some scheme to increase industrial income as rapidly as possible. During the year careful consideration was given to various alternative schemes by the advisory committee, assisted by useful discussions with the Joint Iron Council. It was finally decided in agreement with the Joint Iron Council that the most appropriate scheme was that for an additional grade of membership; the appropriate resolution was approved and adopted at an extraordinary general meeting held June 18. At September 30, 1959, the subscription income from United Kingdom ordinary (B) members, numbering 250, amounted to £22,158 12s. 1d. The Council considers that the initial response is encouraging, and would emphasize that it is in the interests of every member-firm to transfer to the ordinary (B) grade of membership in order to take advantage of the full services provided by the Association. It is particularly important that industrial income should be increased as rapidly as possible as it is impossible to make a start on the new laboratory block until sufficient funds are available.

Personalia

On December 31, 1958, Dr. J. G. Pearce, C.B.E., director of the Association for more than 30 years, retired, and Mr. H. Morrogh was appointed director, with Dr. H. T. Angus as deputy director. On December 15, 1958, a dinner was held at the Connaught Rooms, London, attended by 174 people, to pay tribute to Dr. Pearce's services to the Association and the ironfounding industry over so many years. Mr. E. Player, C.B.E., president of the Association, took the chair, and Dr. Harold Hartley, C.B.E., proposed the toast of Dr. Pearce. Mr. Player, on behalf of the Council and members of the Association, presented Dr. Pearce with a cheque for £900, and a silver tea-service and salver. The Council has retained Dr. Pearce as a consultant for two years, commencing January 1, 1959, primarily with the object of assisting in the changeover to the new membership scheme.

The director, Mr. H. Morrogh, visited the USA in July, 1959, to contribute a paper on the formation of spheroidal graphite in nodular irons to a course on ductile iron at New York University. In the short time available the director also visited a number of American foundries and research organizations.

The Council has approved the appointment of Mr. I. C. H. Hughes, M.SC., A.I.M. (assistant research manager), as research manager as from July 1, 1959.

On May 28 and 29, 1959, "open days" were held at Alvechurch. On the first day the number of visitors from member-firms totalled 247. On the second day the number was 152, including representatives from other organizations. The occasion was memorable for the opening of the new foundry atmospheres laboratory by Dr. J. G. Pearce, C.B.E., and the inauguration of the new foundry cupola by the president, Mr. E. Player.

In September, 1958, Mr. A. E. Pearce and Dr. J. G. Pearce resigned as trustees on the Association's pension scheme, and the Council appointed Mr. M. M. Hallett and Mr. T. E. Whiteside to fill the vacancies. Mr. T. M. Herbert, M.A., continues as chairman of the trustees.

The "visitors" appointed by the Department of Scientific and Industrial Research, Mr. E. W. Colbeck, M.A., F.I.M., and Professor A. J. Murphy made visits to inspect the Association's work during the year. On June 16, 1959, the Association was honoured by a visit from Sir Cyril Musgrave, the chairman of the Iron and Steel Board, in company with Sir Lincoln Evans, C.B.E., the deputy chairman of the Board.

Research Department

The work of the research department has been continued under the supervision of the research board, and the research committee, supported by its sub-committees: engineering castings, malleable cast-iron, white and chilled iron, sand and refractories, methods of analysis, fuels and furnaces, and light castings.

Shrinkage and Porosity

The degree of nucleation of grey iron, measured by counting the eutectic cells, has been shown to influence shrinkage characteristics and chilling behaviour, particularly in thin-sectioned castings.

Investigations have been carried out in members' foundries to study variations in degree of nucleation and their relationship to the quality of castings produced. Various processes to decrease the degree of nucleation and improve soundness have been studied in the laboratory. A series of castings with varying degrees of nucleation have been water-quenched at different stages of solidification and have been examined microscopically to determine the progress of eutectic solidification. Similar studies are in progress on the influence of pouring temperature.

A programme of work on the soundness of ingot moulds in conjunction with the foundry techniques group of the ingot moulds sub-committee of the British Iron and Steel Research Association has now been completed. The effect of casting expansion during solidification on shrinkage formation in nodular-graphite irons and the significance of mould hardness in producing sound nodular-iron test castings, have been examined.

Gases in Cast Iron

Investigations have shown that pinholing defects in grey iron are caused by hydrogen pick-up from the sand mould, promoted by traces of aluminium in the iron, and recent work shows that a similar mechanism is responsible for pinhole porosity in white irons used in malleable-iron production, where aluminium is a common graphitizing addition. A similar effect in some pearlitic malleable irons is ascribed to increased manganese content.

It is established that the maximum inoculating effect of ferro-silicon in grey iron is only achieved when the ferro-silicon contains sufficient aluminium. A search has been made for alternative elements to aluminium which will ensure efficient inoculation without causing pinholing.

Vitreous Enamelling

Following the work on gas evolution from cast iron in connection with the blistering of vitreous enamels, a further programme has been approved for continuance of the work. Factors affecting the nature of the casting skin and its further treatment by annealing and shot-blasting will be studied in relation to blistering of applied enamels.

Mechanical Properties of Cast Iron

An extensive programme is in progress to obtain data on the maximum safe working temperatures for cast iron with the object of raising the limit at present set upon its use in steam engineering applications. The first part of the investigation reported a number of growth tests and was mentioned in the last annual report. A number of supplementary tests on growth have been carried out since, both in air and steam. The second part of this investigation has now been undertaken to study the creep properties of one of the irons, using times up to 5,000 hours and temperatures up to 400 deg. C. Stress/strain relationships have been studied for cast irons of differing structures and with both ductile and brittle matrices.

Work initiated to study the effect of phosphorus in grey cast iron up to 1.0 per cent. with a range of silicon contents in inoculated and uninoculated irons has been completed. Phosphorus was found to increase tensile strength up to about 0.8 per cent. regardless of whether the phosphorus was increased in the charges or as a late addition. This increase is associated with an increase in eutectic cell number with increasing phosphorus content. The general relationships between tensile strength, carbon equivalent and Brinell hardness which commonly apply to grey irons are not applicable to phosphoric irons unless correction factors are used, since increasing the carbon equivalent by increasing the phosphorus content, also involves an increase in hardness. An increase in phosphorus content was also examined in relation to modulus of elasticity for inoculated and uninoculated irons.

A comprehensive investigation has been made of the effect of variations in section size on the mechanical properties of grey cast iron, with special reference to eutectic cell number, form and quantity of graphite, form of pearlite and quantity of ferrite. These factors affect the tensile strength and the stress/strain curve, and the rate at which the modulus of elasticity varies with stress. It has been shown that Brinell hardness and modulus of elasticity are not related to eutectic cell size and are only slightly affected by graphite-flake size. The former property is influenced primarily by matrix structure and the latter by graphite quantity. The coefficients of section sensitivity for tensile strength and Brinell hardness were found to be higher in weak irons than in strong irons.

Malleable Cast Iron

A survey has been made of the properties at present obtained both in test-bars and commercial castings in pearlitic-malleable iron. Indications are that the properties obtainable in as-annealed high-manganese pearlitic-malleable are inferior to those obtainable in heat-treated good-quality blackheart-malleable iron. A programme has now been undertaken, however, to determine the properties which can be obtained by heat-treating normal and high-manganese blackheart irons, commercially produced. The results will be considered when framing a projected British standard for pearlitic-malleable iron. A preliminary survey has been made of the hardenability of commercial pearlitic-malleable irons.

A programme of work has been begun to determine means of obtaining optimum mechanical properties in a normal commercial blackheart-malleable iron. In particular, the use of increased phosphorus contents to raise the proof stress without causing serious embrittlement, has been studied.

The properties obtainable in blackheart irons for a wide range of carbon, silicon and phosphorus contents are being determined. Blackheart-malleable iron shows no true yield point, and 0.2 per cent. and 0.5 per cent. proof stress values have been used throughout; a strain recorder is being developed to determine these values on test-bars of various British and Continental sizes. The use of combined additions of bismuth and boron to give satisfactory annealability in such irons has been demonstrated. Means are being

British Cast Iron Research Association

studied to avoid the formation of surface carbides in blackheart-malleable iron.

The investigation on inverse greyness is completed and it is established that this defect can generally be prevented by avoiding mottling tendency. Inverse greyness in whiteheart-malleable seems to occur under the same general conditions as for blackheart, though it is a much less common defect in whiteheart-malleable iron.

Graphite Formation

A study of the nature of eutectic cells shows that within a eutectic cell, the graphite flakes are inter-connected and constitute a zone of weakness. An improvement in strength is generally given by increasing the eutectic cell number. Phosphide eutectic is shown to exist as inter-connected filaments, even at around 0.4-per cent. phosphorus. This information has assisted the understanding of the influence of phosphorus upon the shrinkage behaviour of grey iron. New evidence has been obtained to show that under-cooled graphite originates by direct solidification and not *via* a first formed carbide. Investigation of the melting points of the grey and white irons' eutectics shows that at a suitable heat-treatment temperature, the white-iron eutectic may melt and re-solidify as a grey-iron eutectic. Only under these conditions can heat-treatment of white irons yield normal flake graphite.

Corrosion

An investigation of the corrosion of cast-iron in the engine waterways of road vehicles, due to anti-freeze solutions, has now been completed. A progressive decrease in the inhibitor content of the coolant and a simultaneous increase in acid content occurs with time. This acid is ascribed to the oxidation of the glycol.

Work on the cathodic protection of ships' propellers has been chiefly concerned with the degree of anode shrouding required and the shaft-to-hull potentials for various types of ship, and propeller design, with the object of defining recommendations for cathodic protection. Some work is in hand on the examination of various corrosion-inhibiting propeller coatings. This work is carried out with the co-operation of the British Shipbuilding Research Association

Sands Research

Construction of the power unit and heater for the new di-electric heating unit is almost complete. Preliminary tests indicate that a rate of heating of 1,000-deg. C. per min. will be obtained with standard test-pieces. The new equipment has been so designed that the atmosphere surrounding the test-piece can be controlled. Building of the testing equipment has begun.

The results of an investigation of the properties and testing of materials used in the CO_2 Process have been published and work has now begun on the causes and prevention of metal penetration into CO_2-Process moulds. The strength and deformation to rupture of a wide range of sands has been measured with slow rates of strain. The range for which this method is satisfactory includes most of the clay-bonded sands in use and a report has now been published.

An investigation of the effect of mould rigidity on casting soundness is continuing and has been extended to cover the use of very hard greensand moulds and moulds containing various additions. A study of the effect of peat upon the properties of moulding sand at room and high temperatures has shown that, under some easily defined conditions, peat has an advantage over other materials available.

White and Chilled Cast Irons

Work on hot tearing, using restrained bar test-castings, has continued, with special reference to composition and test-casting design. The solidification sequences of white irons with (*a*) a ledeburitic eutectic structure and (*b*) a plate-like eutectic structure, have been studied by means of cooling curves and the examination of quenched samples.

The study of the influence of the degree of nucleation on chill depth and mottle spread continues, with reference to superheating and furnace holding time, composition, and other factors influencing the number of eutectic cells. The composition and melting conditions required to produce chilled-roller castings commercially, to closely-specified chill, hardness and strength properties have been studied, and the results have been successfully applied commercially.

High-chromium Irons

The influence of melting and casting conditions and of titanium and nitrogen additions on the grain size of 30-per cent. chromium irons has been studied and the relative importance of the different factors shown. Work has begun to study the influence of various heating cycles on the structure and properties of 30-per cent. chromium irons of various ranges of composition.

Ingot Moulds

In co-operation with the British Iron and Steel Research Association the BCIRA continues to examine the structures and compositions of ingot moulds to determine factors influencing mould life. There is also co-operation with a group of member-firms for the same purpose. Much of this investigation involves the answering of members' specific problems, most of which are concerned with factors affecting ingot-mould and bottom-plate life.

Cupola Project

During the year, installation of the experiment cupola plant has been completed and running trials have commenced. The plant comprises a 30-in. internal-diameter cupola which can be operated with hot or cold blast, with or without water cooling and with acid, basic or neutral linings. The two-stage blast heater will enable blast temperatures up to 800 deg. C. to be investigated. The plant is extensively instrumented, the apparatus including air-weight controller, blast-temperature controller, blast-pressure recorder, metal-spout-temperature recorder, charge-level indicator, water-volume and temperature indicators, and automatic top-gas analyzer. Ancillary equipment includes a bucket charger, wet-spark arrester, and a pig-casting

machine to dispose of all the metal which is likely to be produced. Stockyard equipment includes a 2-ton gantry crane and covered bunkers for holding charge materials.

Proving trials on the blast heater are not yet completed, but all the other equipment is functioning correctly and the initial programme covers the melting of about 80 tons of accumulated scrap test-castings to produce a uniform stock of pig-iron for future use. Melting the scrap is providing an opportunity for the staff to become familiar with the cupola operation and to make final adjustments to the plant. Full accounts of the installation have been published in the FOUNDRY TRADE JOURNAL (May 28, 1959), the BCIRA *Journal* (June, 1959) and elsewhere.

Analytical Research

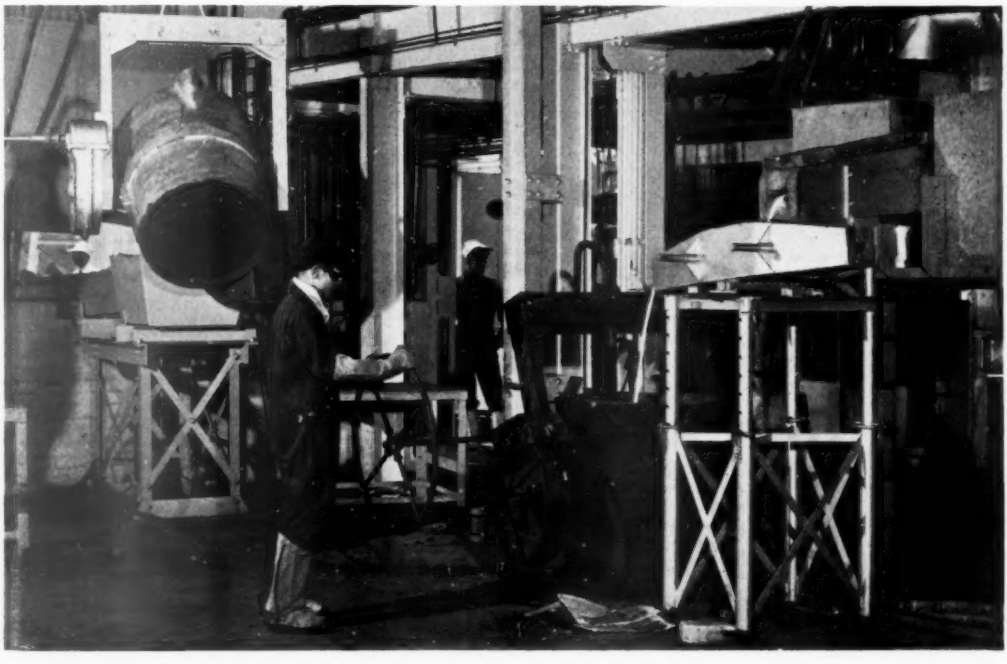
A conference on the theme "Modern Methods of Analysis" was held in London in June, 1959, with the objective of bringing new analytical methods to the notice of foundry chemists. The first part of the handbook *Selected Methods of Analysis of Foundry Materials* was published to coincide with this conference.

Work during the year has included the development of a rapid method for the determination of magnesium in nodular cast-iron, the examination of the combustion sulphur method using radiochemical techniques (in conjunction with Wolverhampton Technical College), and a method for the determination of very small amounts of cobalt.

A rapid method of sampling liquid cast-iron by using a rotary sampling machine has been examined and found to be very satisfactory. Much attention has been paid to instrumentation, improvements have been made to the cathode-ray polarograph and spectrophotometer, and a recording flame spectrophotometer has been constructed. Comparative tests of instruments for absorptiometric analysis have been made and the results have been published. In slag analysis work has continued on a volumetric method for silica and on a rapid gravimetric method. Analytical research has also been carried out in conjunction with the British Iron and Steel Research Association.

Work has been resumed on the spectrographic analysis of slags with the object of establishing a technique suitable for routine use. A series of synthetic slag samples has been made from pure oxides and used as calibration standards to test various techniques. Work has been undertaken to obtain standard compositions of nodular iron for spectrographic analysis. The spectrographic analysis of trace elements is undergoing re-examination, to enable the standardization of the various spectrographic methods to be brought up to date.

The new BCIRA experimental cupola in operation, showing filling of a ladle from the tilting spout and also another ladle in position over the pig-casting-machine launder (see also JOURNAL, *May* 28, 1959).



British Cast Iron Research Association

Development Department

The development department has continued to maintain contact with member firms and users. Many enquiries which are received can be dealt with by work carried out in the routine laboratories; others, however, may involve special consideration and investigation, and it is this latter group which absorbs the greater part of the department's activities. These enquiries at Alvechurch reached a record level for the 12 months ending June, 1959, when a total number of 897 special enquiries was received, compared with a previous maximum figure of 873. The total number of individual visits paid by members of the Alvechurch staff rose from 366 in the year ending June 30, 1958, to 454 in year ending June 30, 1959. The total number of member-firms visited rose from 217 to 235.

The reduction in the demand for castings which was particularly apparent for this year over the whole of the country was therefore not reflected in the number of problems submitted to the Association, and enquiries appeared to increase as a direct result of the increased competition resulting from the limitation in demand. Problems relating to scrap castings appeared to predominate, but requests for assistance in cupola operation and advice on types of iron required for particular castings, or the design of castings for specific purposes, were also frequent.

Members of the department's staff have also been active on committees of enquiry dealing with cupola-coke quality and international standards, and investigations are still proceeding into the identification of dross and slag defects, cracking of diesel-engine components, materials for use in glass-bottle moulds, wear resistance, heat-treatment, and other projects. These investigations, which invariably commenced as a direct result of enquiries received, continue to occupy any time available to the staff that is not devoted to problems of immediate urgency, and the experienced gained is always immediately available and is constantly being reinforced by data gained from fresh enquiries. However, the need to deal promptly with urgent day-to-day enquiries inevitably reduces the rate at which these investigations can be completed.

Foundry Atmospheres Section

The foundry atmospheres section, under the direction of Mr. W. B. Parkes, occupied the new foundry atmospheres building early in 1959 and the building was formally opened by Dr. J. G. Pearce on the "open day" held on May 28, 1959. These new laboratories for the first time provide the staff of this section with full facilities, and include instrument rooms, a spacious laboratory for full scale ventilation and air movement tests and a basement in which heavy equipment can be housed, access to which is obtained through movable panels in the floor of the laboratory above, making possible the full scale reproduction of down-draught ventilation. The laboratories provide the most up-to-date equipment in the country for the study of dust formation and control, and air movement. An experimental programme, under Mr. R. I. Higgins, includes dust surveys in various foundries with suitable equipment, and the testing of full-size prototypes of dust-control systems for member-firms with special problems. The problem of ascertaining the free silica content of foundry dusts has been tackled by the purchase of an X-day diffraction apparatus, with which it is proposed to examine dusts obtained during the sampling surveys which are going on continually.

The advisory section, under Mr. W. H. White, deals with external enquiries, smoke and grit emission from furnaces and dust control in fettling shops, and has been very fully occupied as a result of the Clean Air Act. The Clean Air Act itself has raised very serious problems in connection with emissions from hot-blast cupolas, and in conjunction with the Council of Ironfoundry Associations a series of meetings with the Alkali Inspectorate has led to a tentative agreement between the industry and the Inspectorate upon the means to be employed for control of such emissions. These discussions have involved the department in considerable work, and surveys and investigations carried out by Mr. F. M. Shaw have provided much of the data upon which the final agreement was reached.

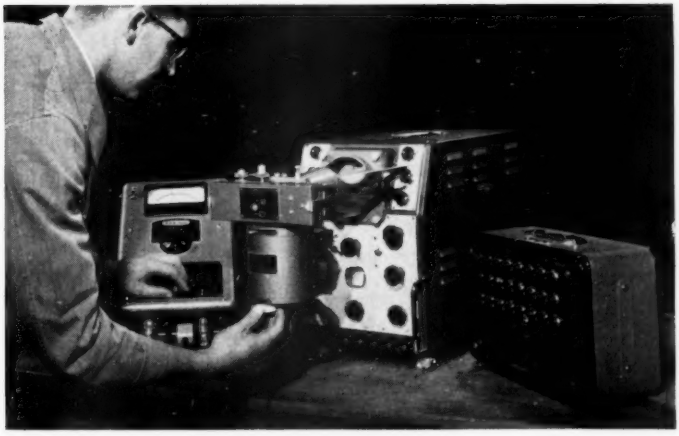
Scottish Laboratories

The Scottish Laboratories at Blantyre, under Mr. A. N. Sumner, carry out advisory work in the Scottish region and have shown a very marked increase in enquiries both from the foundries and from users of iron castings. Major problems have increased from 490 in the preceding year to 544 in the 12 months ending June, 1959, and an increase in routine examinations of approximately 25 per cent. has also taken place. These laboratories are now fully equipped to deal with almost any foundry or engineering problem, and the success of the policy of maintaining the standard of equipment and service has been justified by the increased volume of work which has resulted.

Foundry Operations Section

The staff of the foundry operations section have made some 46 visits to members' foundries to give advice on production methods and foundry layout. These visits, which have been made at the request of the foundry concerned, have dealt with a wide variety of aspects ranging from scrap analysis to cupola charging and foundry layout. Each visit has been supplemented by a report, and in many cases a diagrammatic sketch embodying any proposed revisions to layout has also been sent. Schemes for mechanized layouts have been developed, and in one case the section has co-operated extensively with a firm engaged in building a new foundry, and in the installation of a mechanized unit.

Although a large percentage of the work has tended to be of a technical character (*i.e.*, foundry practice, or mechanical handling), the application of work-study methods is being actively pursued.



Strain-measuring apparatus, which is capable of measuring strain alternating at rates up to 200 cycles per second, used at the BCIRA for determining stresses in all kinds of engineering components.

As a "fact-finding" procedure such techniques are proving of great value, and in this respect considerable interest is being shown in memomotion.

During the year a new ciné camera, and a special projector for frame-by-frame analysis have been acquired. The scope of application of memomotion technique to the study of foundry processes is being examined, and it has been used in two or three members' foundries with beneficial results. It is expected that increasing use will be made of this technique in the coming year.

Memomotion is also being used as a research tool; in particular, to make a special study of snap-flask moulding methods, which are of wide interest and application in the ironfounding industry. Used in this way, the technique will reveal the various patterns of working adopted by different operators, and will enable a quantitative comparison to be made. Certain deliberate changes in procedure or equipment have also been made and it is hoped to be able to evaluate these changes quantitatively. This work has been initiated during the past year and progress reports will be prepared periodically.

During the year, one member of the section attended a short course on work simplification held under the auspices of the DSIR industrial operations unit, while another member participated in a course on the application of film analysis in work study, at the University of Birmingham. Two reports have been prepared, the first a study of labour performance in cupola charging, and the second on the consumption of raw materials in the foundry.

Information Department

The Council has approved a change in the title of this department, previously known as the intelligence department, to the information department.

General Work and Publications

Research reports published in the BCIRA *Journal of Research and Development* totalled 26 and a number of extended surveys of the literature on various subjects were published in the BCIRA *Bulletin and Foundry Abstracts*. A plan put forward to consolidate these two publications from January, 1960, onwards under the title of BCIRA *Journal* was approved by the information committee and the Council. The new *Journal* will be slightly increased in size, and there are changes in the cover, the paper and the typographical arrangement. It will be published, as before, in alternate months and will be sent free to members; to non-members it will still be available on subscription terms, which have been slightly increased in order to cover the rise in printing charges during the last 10 years.

Eighteen external reports, consisting of lectures given by members of the staff to outside bodies or contributed to technical journals, appeared during the year and have been made available to members. Members of the staff contributed 13 lectures to other organizations and 22 lectures were also given as part of a post-graduate course at Birmingham University on foundry science and technology, October, 1958, to May, 1959. In addition, papers were contributed to the International Foundry Congress at Liège in October, 1958, to the annual conference of the Institute of British Foundrymen at Scarborough in June, 1959, and to a Foundry Colloquium at Aachen in March, 1959. This Colloquium was attended by Mr. G. R. Woodward, information department manager, and by Mr. R. Godding of the sand section. Mr. I. C. H. Hughes, research manager, was present in person to give a lecture to the Convention of the American Foundrymen's Society at Chicago in April, 1959.

The Department gave some help in connection with the 250th anniversary of the first successful use of coke in iron making at Coalbrookdale, organized by a National Committee under the chairmanship of Sir Frederick Scopes.

Conferences

A meeting was arranged for members in London on December, 16, 1958, to demonstrate the automatic moulding and pouring plant at George Fischer's, Schaffhausen. A film was shown to illustrate the plant, which was described by Mr. C. Zehnder. A course on effective reading, during which there was a practical demonstration of the Harvard University tests, was held in London, April 15 to 17, 1959.

Another meeting, held in London on April 28 and 29, 1959, was attended by representatives of

British Cast Iron Research Association

member-firms concerned with the production of white and chilled cast iron. The meeting was addressed by the director, Mr. H. Morrogh, who gave a series of papers on the solidification and chilling processes. On June 22 and 23, 1959, a conference on modern methods of analysis was organized in London, and was attended by more than 150 representatives of member-firms.

Exhibitions

The Association contributed exhibits to the Physical Society Exhibition in London, January 19-22, 1959, to the Factory Equipment Exhibition, London, April 7 to 17, 1959, and to the Safety and Factory Exhibition, Birmingham, June 19-26, 1959. In addition, an exhibition of equipment was organized with the co-operation of the Scientific Instrument Manufacturers' Association in conjunction with the methods of analysis conference mentioned earlier.

Foundry Education

Under the Association's training scheme three apprentices have recently completed their indentured apprenticeship and have now been appointed as assistants in the research department to continue their training. The Association has 13 apprentices who have yet to complete their indentures, undergoing training in the various routine laboratories. There are also a number of trainees who are not indentured who are appointed to given laboratories and who will eventually take up permanent appointments in those laboratories. Seven training courses on sand testing and control were held at Alvechurch with a total attendance of 64.

The Association continues to take an active interest in foundry education at all levels and a number of courses are in preparation at technical colleges. The director, Mr. H. Morrogh, has been appointed a member of the Council of Ironfoundry Association's recruitment, training and education committee.

Membership and Staff

The total membership of the Association in all categories stands at 1,281; the staff at present totals 141.

The Report is signed by Mr. E. Player, president; Mr. H. J. V. Williams, chairman of Council; and Mr. H. Morrogh, director.

John Williams' Acquisition

John Williams of Cardiff, Limited, have signed a contract for the purchase of the old Cardiff Foundry, Penarth Road, which was closed in June last. In future it will be known as the Taff River Foundry. Work has already commenced on the overhauling of machinery at the old foundry where castings in special alloys will be produced. A director of the company has stated that no appreciable increase in the labour force is envisaged in the immediate future, as personnel will be transferred from the firm's East Moors foundry.

B. O. Morris (Holdings), Limited—Mr. Hermann Kaufmann has been appointed to the board.

New Catalogues

Automatic Couplers. The English Steel Castings Corporation, Limited, River Don Works, Sheffield, in publication No. A.C. 3/1, illustrate and describe the Willison type of automatic coupler for use in mining and other industries. Its major components are made from heat-treated manganese-steel. The brochure is pleasingly produced and includes a wealth of technical data.

Portable Electric Mould Dryers. In publication No. R31, the Electric Resistance Furnace Company, Limited, Netherby, Queens Road, Weybridge, Surrey, cover the main features of the Efco-Brown Boveri type of plant which the company is now manufacturing. The illustrations in the brochure show a few interesting applications, whilst the letterpress discloses the principles involved. Three sizes of mould dryers are detailed as to technical data, dimensions and weight.

Colloidal Dispersions. Graphite Products, Limited, Northfields, Wandsworth Park, London, S.W.18, in publication GP 53/59, deal with a phase of lubrication, invariably complicated by the conditions of the applications. To quote from this four-page brochure:—"The choice of dispersion depends upon the application itself, and the function to be performed. Such factors as temperature, pressure, etc., may have to be considered. Thus it is a case of leave it to the experts, yet the case of coating dies seems simple enough."

House Organs

Nickel Bulletin—September/October 1959. Issued by the Mond Nickel Company, Limited, Thames House, Millbank, London, S.W.1.

This issue contains more than 100 abstracts of technical literature pertaining to nickel and nickel-containing materials. The abstracts include those from papers reporting investigation of the properties and fabrication of ultra-high-strength constructional steels. In the section on cast irons, an item refers to a comprehensive evaluation of the suitability of alloy irons for use in crushing and grinding plant. Nickel and its compounds are represented in references to papers on extraction, properties and analysis. Literature abstracted in the other sections of the issue ranges in subject matter from the properties of non-ferrous alloys and permanent-magnet materials to the operation of nickel-plating solutions and the influence of plating variables on the coatings obtained.

Foseco Foundry Practice, No. 137. Issued by Foundry Services, Limited, Long Acre, Nechells, Birmingham 7.

This issue carries articles based on the papers which won the joint second prize awarded in a recent competition organized by Foundry Services, Limited. The second article on the foundry of 1978—the subject of the competition—is reminiscent of Burmeister and Wain's Copenhagen foundry, which was installed several years before the 1939 war, and is still functioning. The articles in this magazine certainly have real interest for those creating new foundries or undertaking major alterations or extensions; they are not, however, meant to be followed in detail, as only lines of thought are indicated. Other articles cover a defect in a brass door-handle and the use of thermo-electric pyrometers.

Section devoted to the technology of producing DIMENSIONALLY ACCURATE CASTINGS

Atmospheric Dust in Investment Foundries*

By C. M. Stoch, Dipl. Ing., F.I.M.

Atmospheric dust has long been recognized to be a health hazard in some industries, and also to have damaging effects on equipment, apart from contributing to unpleasant working conditions. However, because the investment-casting industry is comparatively new, little is known as yet about its particular dust problems. It is hoped that this paper, which is based largely on work carried out in the general field of industrial health by the British Steel Castings Research Association, will make all the general aspects more familiar to founders.

In an industrial country the contamination of the atmosphere with dust and fumes concerns not only people engaged in various industries, but also the whole population. Air contaminants are always a nuisance, and may be dangerous. This point can be illustrated by recalling that, during the four-day London fog in December, 1952, the concentrations of smoke and sulphur dioxide rose to over four times their usual values, causing the deaths of 4,000 persons.

Foundry workers, in common with miners and workers in certain other occupations, are subjected to the inhalation of dusty atmosphere containing a dangerous constituent. In the foundry, this constituent is free silica, which originates from sand and other silica-containing materials used there. The inhalation of silica dust over a period of years may result in a proportion of workers developing silicosis, which in its later stages is progressive and disabling.

Extensive research has been carried out, by many organizations, into the various aspects of atmospheric dust in industry. The British Steel Castings Research Association has pursued, over a period of several years, an active research programme in the industrial health field, and it is considered that many of the results obtained and much of the experience gained may be successfully applied to the investigations into the dust problems associated with the production of investment castings. Because the investment-casting industry is comparatively new, little is known as yet about its dust problems and the degree of their importance. There is evidence from the USA, however, that in some investment foundries a very high percentage (up to 63 per cent.) of respirable particles of free silica can be present in the foundry atmosphere[1].

Respirable Particles

Not all dust breathed reaches the terminal air spaces of the lungs, *i.e.* the alveoli. A large proportion of dust particles over about 10 microns† in size are likely to be caught in the nasal passages or at the back of the throat. Smaller particles which enter the bronchial tubes come into contact with the moist tube walls, due to frequent changes of direction, and some of them are deposited by impact. The smaller the dust particles the lower their momentum, and the greater their ability to move as an integral part of the transporting gas. The result is that only the smallest particles reach the alveoli.

Retention of Certain Sizes of Particle

The trachea and bronchioles are lined with hairs known as cilia, which cause a continuous upward movement of particles deposited in the mucous film, the dust being eventually either swallowed or sneezed or spat out. There is very little movement of air in the alveoli, as each alveolus is a dead end, so deposition of dust particles within the alveoli is by gravitational sedimentation. It is shown in Fig. 1 that the percentage of inhaled dust which is deposited here depends on the size of the dust particles. The maximum retention occurs at 1- to 2-microns diameter for particles of unit density and compact shape[2]. At about 0.3 microns retention is minimal, and the particles are mainly exhaled

* This paper, and the following one by Mr. J. Mitton, constitute another instalment of the series of papers presented at the first annual conference of the British Investment Casters' Conference (held at Connaught Rooms, London, on May 11 and 12). Mr. Stoch is head of the plant engineering section of the British Steel Castings Research Association. (See biographical notes on page 559.)

† 1 micron = 10^{-3}mm.

again. Above 5 microns few particles reach the alveoli since they are trapped higher up, and it is usual to refer to respirable dust as containing particles below 5 microns in size.

DUST MEASUREMENT AND SAMPLING

Dust can be measured by two main methods. First, while it is airborne, by measuring either its optical screening effect using a densitometer, or part of the scattered light using a Tyndallometer. The second method is to collect a deposit, which can be obtained by several means including filters, electrostatic precipitation, impingement, thermal precipitation and sedimentation under gravity. This deposit can then be assessed by weighing, optical measurement, physical, chemical or colorimetric estimation, or microscopic examination.

Atmospheric dust in foundries has been sampled by several investigators, who used either an Owens Jet counter, thermal precipitator or Hexhlet sampler.

Owens Jet Counter

The Owens Jet counter is made up of an entrance chamber lined with moist blotting paper to humidify the dusty air, a streamlined rectangular nozzle 0.1 by 1.0 cm. in size, and an impinging surface consisting of a rotatable microscope coverslip. Air is drawn rapidly through the nozzle by a hand pump of 50-ml. capacity, and the airborn dust is impinged on to the coverslip. The pressure drop, and consequent lowering of the temperature produced by the air passing through the nozzle, causes moisture to condense on the particles and eliminates the need for any adhesive on the coverslip. The advantages of the instrument are portability, lightness and ease of operation, but it has several important disadvantages :

(*a*) Assessment is by optical examination under a microscope, the number of particles in various size ranges being counted. This is both tedious and time-consuming.

(*b*) It is a "snap" sampling instrument and, although useful if the spatial or temporal variation of dust concentration is to be measured, a large number of observations must be taken and the results treated statistically if the average conditions of "dustiness" are to be assessed.

(*c*) Large particles and aggregates are probably shattered into smaller particles, thereby giving a high dust count in the small-size ranges.

(*d*) The sample collected is too small for an analysis to be performed by normal micro-chemical methods.

Thermal Precipitator

The principle employed in the Thermal Precipitator, for the collection of dust, depends upon the presence of a dust-free area around a hot wire. The dusty air is drawn by a water aspirator through a slot, across the centre of which is a filament heated to a temperature of approximately 100 deg. C. The air passing the filament precipitates its dust on to a microscope coverglass backed by a brass block mounted immediately behind the filament. The collection efficiency is 100 per cent. for sizes between 0.2 and 20μ, but the unit is subject to some of the disadvantages from which the Owens Jet suffers, *viz:* slow and tedious assessment, and a small sample which is difficult to analyze. Although not a snap sampling instrument, it is normally used for relatively short periods of time. Successful attempts have been made, notably by the Safety in Mines Research Establishment, to improve its robustness and still enable it to be used for longer term sampling. However, it is not, for the other reasons given

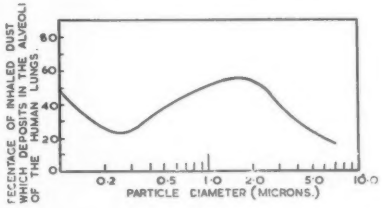


FIG. 1.—*Graph showing how the percentage of inhaled dust deposited in human alveoli depends on the size of the particles* (*Davies*[2]).

above, an ideal instrument for use in foundries. Because of its excellent collection efficiency, however, it is often used as a standard instrument against which the performance of other dust samplers may be checked.

"Hexhlet" Sampler

To overcome the tedious nature of the counting process, instruments have been developed for counting automatically by using photocells and electronic recorders. The apparatus is, however, too costly for routine measurements in foundries. The British Steel Castings Research Association has therefore decided that the simplest and most effective instrument available for this purpose at the present time is the "Hexhlet" sampler, first described by Wright[3]. This instrument is size selective and collects only the dust which is less than 5μ in diameter. In this respect it copies the action of the human respiratory tract. Fig. 2 illustrates diagrammatically the functioning of the Hexhlet instrument.

Sequence of Operation

The air to be sampled is drawn through the instrument at a known and constant rate; coarse particles which would not reach the lung in normal respiration are collected in the first stage of the instrument, the elutriator, while the dangerous dust is collected in a paper thimble through which the air to be sampled is drawn. The air ejector is coupled to a compressed-air line, and induces a partial vacuum in the evacuation chamber which draws the contaminated air from the shop through the elutriator, the constant-flow orifice and collecting thimble. The air ejector incorporates a sound-damping chamber to minimize noise. The elutriator consists of two banks of 58 parallel aluminium

plates, the length and spacing of which are such that 50 per cent. of the dust particles having a free falling speed equal to that of a 5μ sphere of unit density, and all the particles having the free falling speed of a 7.1μ sphere of unit density, deposit by gravitational settlement on the plates and do not, therefore, pass into the collecting stage of the instrument. The constant-flow orifice ensures that air passes through the instrument at a constant flow rate of 100 ± 1 litres per min. The application to the air ejector of any compressed-air line supplying air with a pressure greater than 30 lb. per sq. in. will suck the dust-laden air through the constant-flow orifice at this rate. A pressure gauge is incorporated in the instrument to ensure that the minimum required air-pressure is applied to the ejector. The Soxhlet paper thimble, which collects the dust, is situated directly behind the constant flow orifice.

Calculation of Dust Concentration

After sampling for a chosen period of time the paper thimble is removed from the instrument, the amount of dust collected being measured in one of two ways:

(*a*) The dust can be washed out of the thimble by acetone continuously recirculated over and through the thimble and subsequently centrifuged and weighed.

(*b*) More commonly, the thimble containing the dust sample is incinerated at 700 deg. C., and weighed, and the amount of dust (excluding any carbonaceous matter) is derived by deducting the weight of the thimble ash.

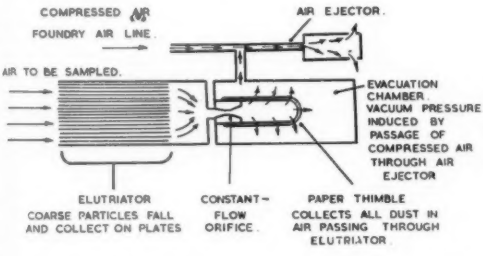

COMPRESSED AIR FOUNDRY AIR LINE
AIR EJECTOR
AIR TO BE SAMPLED
EVACUATION CHAMBER. VACUUM PRESSURE INDUCED BY PASSAGE OF COMPRESSED AIR THROUGH AIR EJECTOR
ELUTRIATOR COARSE PARTICLES FALL AND COLLECT ON PLATES
CONSTANT-FLOW ORIFICE
PAPER THIMBLE COLLECTS ALL DUST IN AIR PASSING THROUGH ELUTRIATOR

FIG. 2.—*Diagram showing how the Hexhlet dust-sampler works* (*Sully*, et al[4]).

Since one then knows the weight of dust collected, the time of sampling and the rate at which the air is drawn through the instrument, the respirable dust concentration in the atmosphere is readily calculated, and is usually expressed as mg. per 100 cub. ft.

Advantages

Apart from the fact that it is size selective, the Hexhlet sampling instrument has several other advantages when used for dust assessments in foundries:—

(*a*) It is robust, and requires for its operation only a compressed-air supply, which is usually always available in foundries.

(*b*) The sample is evaluated by weighing, and can be assessed by relatively unskilled personnel.

(*c*) Since it is a long-term sampler, average dust concentrations can be determined over long periods of time.

(*d*) The sample is sufficiently large for chemical or X-ray analysis.

DUST SURVEYS

Hexhlet sampling instruments have been used by BSCRA for measurements of the average dust concentration in the fettling shops of a large number of steel foundries. The results of an extensive preliminary investigation have shown that a sampling period of three consecutive days is adequate for measurements of average conditions of dust load.

Methods of Free-silica Determination

It is generally agreed that free silica is the major cause of silicosis, whereas the combined silica is relatively harmless. It is important, therefore, that the method used for determining the quartz content of airborne dust samples shall discriminate between free silica (quartz, cristobalite, tridimite) and combined silica (silicate, alumino-silicate, etc.). Experiments carried out by BSCRA, and by the refractories department of Sheffield University, have shown that the chemical method most commonly used, *viz.* that described by Trostel and Wynne[5], is not consistently reliable when used on airborne dust samples of fine particle size. On the other hand, the chemical method for the determination of free silica (utilizing phosphoric acid), described by Schmidt[6], has been found to be reasonably reliable and is used by BSCRA.

X-ray Diffraction

It has been established, however, that the most satisfactory method of determining free silica is the X-ray diffraction method. The accuracy of this method has been established by the examination of synthetic samples of the same particle size as the airborne dusts, and the results have been cross-checked with the Safety in Mines Research Establishment, who regularly use this method for the analysis of colliery dusts. The method has the additional advantage that it enables all crystalline constituents of the dust to be identified (provided that they are present in amounts of at least 1 to 2 per cent.), and also allows the various crystalline forms of silica to be separately estimated.

Results

The results of dust surveys carried out by BSCRA in 58 steel foundries are summarized in Table 1, which gives the maximum, minimum, and average values for total mineral-dust concentration,

TABLE 1.—*Results of Dust Surveys in the Fettling Shops of 58 Steel-foundries.*[4]

	Minimum.	Maximum.	Average.
Dust concentration, mg. per 100 cub. ft.	1.24	22.97	5.09
Quartz Content (per cent.) ..	1.00	37.00	6.90
Quartz concentration, mg. per 100 cub. ft.	0.04	8.40	0.39

Atmospheric Dust in Investment Foundries

the quartz content of the dust, and quartz concentration.

The complete chemical analysis of dust samples has shown that the main constituents of airborne dust in steelfoundries are iron oxides (Fe_2O_3 and Fe_3O_4) and silica. An analysis of all the survey results disclosed that the average quartz content is 7 per cent. Quartz contents of less than 1 per cent. have been measured in a few fettling shops which are large and well ventilated, or where the work-density level is very low. It has been observed that, in general, atmospheric pollution in industrial environments does not materially affect the observed dust concentrations. Furthermore, some of the dust measurements made in steelfoundry fettling-shops have given concentrations and quartz contents lower than the mineral content of the outside atmosphere, *e.g.*, in the steelworks area of Sheffield.

OBSERVATION OF DUST CLOUDS

During recent years the technique of photographing the movement of clouds of fine airborne dust has been developed, and used extensively in the design of exhaust systems. Its application to the dust problem in foundries was first described by W. B. Lawrie.[7] The method is based on a form of Tyndall beam illumination. In principle, it consists of the arrangement shown in Fig. 3: (*i*) a high intensity beam of light, (*ii*) a shield placed between the light source and the eyes of the observer, and (*iii*) a relatively dark background for the observer's eyes. Because a focused and narrow beam is employed, the illusion is created that all the dust is concentrated within the light beam, and the effect is very similar to that observed when sunlight enters a building through a roof ventilator, *i.e.*, all the dust seems to be moving upwards along the beam of sunlight. To observe the movement of dust clouds in the vicinity of a dust-producing operation, the light beam should be moved into various positions.

Smoke Generation

Another method, which is most useful in the study of ventilation air currents in local exhaust systems, is the generation of visible smoke. Cigarette smoke may serve in some circumstances, but specially-prepared smoke generators are more useful. Amongst the most commonly-used chemicals for this purpose are ammonium chloride and anhydrous titanium tetrachloride.

SUPPRESSION OF DUST

The Factories Act of 1937 requires that preventive measures of a practicable nature must be taken to prevent the inhalation not only of dust and fume likely to be injurious or offensive, but also any substantial quantity of dust of any kind. Complete prevention of the formation of dust is seldom possible, although this provides the best solution to the problem. Regulations have been introduced making illegal certain operations and processes known to produce dangerous silica dust, *viz*: the use of dry sandstone grinding-wheels, the use of dry sand in blast cleaning, and the use of silica flour as a parting powder. An example of the elimination of a dust-producing operation is the use of chemical processes in place of mechanical methods for cleaning castings. Dust-control methods can be put under three main headings: general ventilation, good housekeeping and local-exhaust systems. Respirators and masks are used where other methods of dust control are ineffective or impracticable, but personal protection should not be considered a final solution to dust problems.

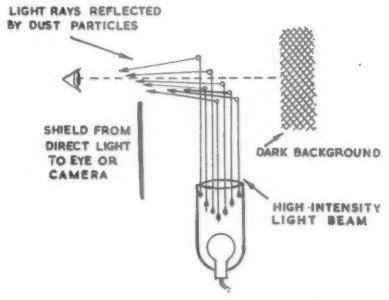

LIGHT RAYS REFLECTED BY DUST PARTICLES
SHIELD FROM DIRECT LIGHT TO EYE OR CAMERA
DARK BACKGROUND
HIGH INTENSITY LIGHT BEAM

FIG. 3.—*Diagram of the Tyndall method of observing airborne dust.*

Ventilation Systems

General ventilation systems very often rely on roof ventilators, their effectiveness depending upon the direction of the wind and the temperature difference between the inside and outside atmosphere; this makes the ventilation unreliable and changeable In some foundries the ventilating air is introduced above the floor level and the contaminated air removed through hoods fitted at the points of dust generation, such as grinding machines, portable tools, fettling benches, knock-out stations, etc. If applicable, this system of downward ventilation provides a more logical way of dust control than upward ventilation, in which all airborne dust has to pass the operator's breathing level on its way to the ventilator.

Local Exhaust

The function of local-exhaust ventilation is to capture the respirable dust close to the dust source before it disperses into the surrounding atmosphere. Fine dust is dispersed from the point of its generation by air currents which may be extraneous, or produced during the operation. The degree of dispersion of dust is a function of particle size. Large particles thrown from a grinding-wheel or cutter may be dispersed, due to their inertia, over a wide area, whilst small particles are dependent upon air currents for their dispersion. Because of their very small mass and kinetic energy, small particles are incapable of sustained flight, and cannot be projected far from the point of generation. A

particle of abrasive of 10-micron size thrown from a wheel at 10,000 ft. per min., will fly to about 1 in. in still air, but a $\frac{1}{16}$-in. particle projected with the same initial speed may be thrown 100 ft. Fine dusts in suspension drift with the general air movements and must be controlled, therefore, by controlling the flow of the entraining air. Table 2 gives the settling rate for silica particles of 10, 5 and 1 micron. While particles of 10μ in size fall fairly rapidly, particles of 1μ in size fall very slowly, and under normal indoor conditions, where air movement is never completely absent, they stay airborne indefinitely.

TABLE 2.—*Free-falling velocity of Silica Particles in Still Air.*

Particle size (μ).	Free-falling velocity (cm. per min.).
10	189.6
5	47.4
1	1.8

Positioning of Hoods

In considering exhaust hoods it is important to remember that all suction openings tend to draw air equally from all directions, and that the velocity drops rapidly as the distance from the hood increases. This is illustrated in Fig. 4, in which distances are expressed as percentages of hood-face diameter, and velocities as percentages of hood-face average velocity. Exhaust hoods must be placed very close to the source of dust, and wherever possible must enclose it. Dellavalle[8] has shown that the centre line velocities are affected not only by the distance from the hood face, but also by the hood-face area, and has given the following relationship:

$$y/(100-y)=0.1\,a/x^2, \text{ where}$$

y = velocity in per cent. of face velocity.
a = hood-face area
x = distance from hood face

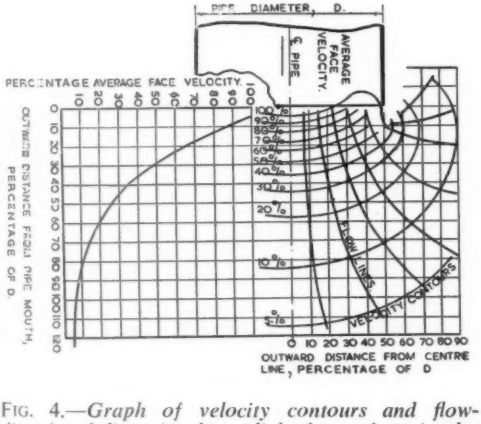

PIPE DIAMETER, D.
AVERAGE FACE VELOCITY.
PERCENTAGE AVERAGE FACE VELOCITY
OUTWARD DISTANCE FROM PIPE MOUTH, PERCENTAGE OF D
CENTRE LINE VELOCITY
VELOCITY CONTOURS
OUTWARD DISTANCE FROM CENTRE LINE, PERCENTAGE OF D

FIG. 4.—*Graph of velocity contours and flow-directional lines in the radial plane of a circular suction pipe. The contours are expressed as a percentage of the opening velocity.*

This indicates that, for the same exhaust rate, large hoods are effective over greater distances than small hoods. Contours representing the same percentage of face velocity lie farther from the hood face. An improvement in the effectiveness of the hood can be obtained by providing a flange around the opening. In recent years extensive experimental work has been carried out on the development of local-exhaust systems. This has resulted in the provision of effective dust control on grinding machines and fettling benches. It is obvious, but not always remembered, that an exhaust hood alone will not control dust without an adequate volume of air to convey the dust into the exhaust hoods; regular maintenance of the ventilation equipment and check-up of the exhaust volume are essential to ensure an efficient control of dust.

CONCLUSION

A considerable amount of information on dust problems in general foundries is now available, and it is considered that this may be successfully used to improve conditions in investment foundries. To assess the health hazard it is essential to measure the concentration of atmospheric dust and to examine the samples; in particular, the amount of free silica, which is the most dangerous constituent, must be determined. Methods of doing this, and of observing and recording dust movements, are well established. It should therefore be possible to check the existing conditions and obtain information on how to improve on the present methods of dust suppression.

Acknowledgment

This paper is based largely on work carried out in the field of industrial health by the British Steel Castings Research Association, whose director and Council have agreed to its publication.

REFERENCES.

[1] Turbich, G. E., *et al.*, "Occupational Health Studies in the Investment-casting Industry." A.M.A. Archives of Ind. Health, March 1957, **15**, 223-244.
[2] Davies, C. N., "Dust is Dangerous," London, 1953.
[3] Wright, B. M., "A Size-selective Sampler for Airborne Dusts." *Brit. J. Indust. Med.*, October, 1954, **11** (4), 284-288.
[4] Sully, A. H., Stoch, C. M. and Slater, J. M., "Measurement and Control of Dust in Foundries." *British Foundryman*, April, 1959.
[5] Trostel, L. J., and Wynne, D. J., "Determination of Quartz (Free Silica) in Refractory Clays." *J. Amer. Ceram. Soc.*, 1940, **23** (1), 18-22.
[6] Schmidt, K. G., "Determination of Free Silica by Decomposition with Phosphoric Acid." *Berichte der Deutschen Keronmischen Gesellschaft e.V.*, December, 1954, **31** (12), 402-404.
[7] Ottignon, R. F., and Lawrie, W. B., "Observation and Control in Foundry Dressing Operations," Inst. of Brit. Foundrymen, *Proceedings* 1951, **44**, A233-A253.
[8] Dellavalle, J. M., "Exhaust Hoods," New York 1952.

DISCUSSION

After Mr. Stoch had shown the BSCRA film "Let's Clear the Air," the CHAIRMAN (Mr. N. Walker of Hadfields, Limited) asked Mr. Armitage to open the discussion.

Is all Dust Harmful?

MR. D. H. ARMITAGE (P.I. Castings (Altrincham), Limited), began by saying that, apart from the requirements laid down in the Factories Act, one owed a duty to one's employees, and that moreover

productivity would be increased by pleasant working conditions. However, there could be a danger in the tendency, prevalent in the investment-casting industry, to deny the existence of the dust problem because non-siliceous materials were in use. He then asked whether all dusts, whatever their composition, were not merely undesirable, but harmful to health, and secondly, what was the maximum allowable level of contamination. As the investment-casting industry was a new industry, he continued, there was an excellent opportunity to obtain fundamental information which could be of value to other industries. Moreover, it was possible to observe these conditions throughout the length of service of one man. One of the difficulties in steelfoundry work resulted from the fact that there was no opportunity to gather statistical information. When the speaker's firm had built a foundry three years previously, they had exhausted all potential dust-producing points. In addition, over the past three years, they had had a full-plate X-ray examination of all workers. The firm had been in existence for some seven years, and, on each X-ray examination, every plate had been clear. The missing information related to the level of dust concentrations under which they were now operating in the various shop sections. Mr. Armitage then asked if Mr. Stoch could tell him whether it would be a practical proposition to set up a dust-sampling and estimating department in his works, or could a dust-sampling service be obtained from commercial organizations, and said that one of the greatest difficulties in his firm was to persuade workers to use the protective equipment provided. They also provided vacuum-cleaners for the cleaning of clothes, but workers preferred to shake the dust off, so that it entered into the breathing zone.

All Dusts can cause Trouble

MR. C. M. STOCH replied that there was no doubt that *any* dust was at least unpleasant; some were toxic, in particular silica and asbestos dusts, but, generally, any type of dust, even if it was not toxic, would eventually cause some lung trouble. It was now recognized that any dusty atmosphere would lower workers' resistance to lung trouble, including tuberculosis. There were no standards in the UK at the moment for maximum permissible dust-concentration in foundries. Some standards had been introduced, particularly in the coal-mining industry, and these included figures based on the dust-particles count, using thermal precipitators. Mr. Stoch continued that he believed that standards relating to dust in foundries had been introduced in some parts of the USA. He felt that, in the UK, the Inspectorate of Factories took the view that any dust was bad, and where a mixture of dusts occurred which contained even a small percentage of silica, it was not possible to exhaust the silica dust only, and leave the rest in the air—therefore it was necessary to exhaust all the dust. The X-ray examination of workers had been used in the steelfounding industry for many years, and had proved to be useful. However, he concluded, he would like to add a word of warning—it took many years for an operator working in a dusty atmosphere to develop silicosis.

MR. ARMITAGE then said that his firm had been doing X-rays for three years—the foundry had been in operation for seven to eight years.

MR. STOCH then emphasized that, even after seven years of operation without having had a case of pneumoconiosis, it could not be taken for granted that conditions were absolutely safe. In some cases workers had developed silicosis after 15 or 20 years' work in a foundry.

MR. ARMITAGE agreed with Mr. Stoch, but said that surely the important point about X-ray examination was that it was possible to discover the slightest sign of lung change and do something about it.

Dust-sampling Procedures

MR. STOCH then said that, with regard to the setting up of dust-sampling procedures, the use of the Hexhlet dust sampler, and the assessment of samples, was very simple and did not require a skilled operator. The sampler required only compressed air or an electrically-operated pump, and, for the assessment of the samples, a laboratory furnace was required in which they were incinerated at 700 deg. C., and a balance, which was usually available in any laboratory.

The assessment of free silica in samples was more complicated and, at the BSCRA Research Station, the X-ray diffraction unit was used and samples were now assessed on a routine basis. This was part of the Association's service to Members. A number of steelfounders now used the Hexhlet dust sampler regularly—they incinerated the samples, and then sent it to BSCRA for the assessment of free silica. There was no need to stress the value of this procedure, but the routine checking of dust concentration gave some indication as to whether conditions were improving or whether they were getting worse. As foundries were installing more and more equipment for the control of dust, the regular checking of dust concentrations in the atmosphere provided reliable information on whether this expenditure was giving favourable results.

Persuading Personnel to wear Respirators

Very great difficulty still existed, he continued, in persuading men to wear respirators regularly. Nearly all steelfounders now had a well-organized respirator service, which encouraged the men because they saw that care was taken and money spent to keep the respirators in good working condition. On the other hand, wearing respirators all day, especially on a hot summer day, was very trying. Moreover, the more efficient the respirator was from the point of view of the retention of respirable dust, the more difficult it was to breathe through it. Two steelfoundries had introduced an air supply into the cavity of the normal type of respirator, in order to improve the comfort of

wearing and breathing through it. This innovation had been particularly welcomed by those engaged in powder washing and powder burning, where, in addition to dust, discomfort resulted from heat. In one foundry which had introduced this development about three years ago, the workers were so impressed that they requested the management to introduce more respirators of this type—a very encouraging case, because normally the management had to urge the workers to wear respirators.

MR. ARMITAGE then asked whether Mr. Stoch considered that a survey, such as that suggested, would add to knowledge of dust problems at this stage.

MR. STOCH said that it would, most definitely, especially as the only available data were contained in an American paper. In some foundries, where the air apeared to be clean, sampling had revealed quite a high concentration of atmospheric dust.

Counting Devices

MR. H. LISTER (Fairey Aviation Company, Limited) entered the discussion here by remarking that, using microscopic techniques, at a particle size of ½ to 2 microns, great difficulty arose in separating the particles, as they tended to agglomerate, possibly due to surface attraction.

MR. STOCH replied that counting constituted a great difficulty in assessing the concentration by particle size using, for example, thermal precipitators, or an Owen's Jet. It was not only time-consuming and tiring, but required a skilled operator. Automatic counting-devices were now on the market which made it possible to count the particles in various size ranges accurately and efficiently, but they were expensive and therefore not within the reach of an average foundry. This was one of the reasons why BSCRA had adopted the Hexhlet dust sampler.

Use of Marble Powder

MR. A. DUNLOP (W. J. Hooker, Limited) then asked whether Mr. Stoch had seen a reference to the use of marble dust instead of iron powder for cutting stainless-steel.

MR. STOCH said that he had not, but understood that the Russians were using fine silica powder for that purpose in order to form a lower melting-point compound between the chrome oxide and the silica. They claimed that it was effective and, of course, much cheaper than iron powder.

MR. DUNLOP asked whether there was any health hazard in using marble powder.

MR. STOCH replied that in normal powder washing there was an excess of iron oxide, which tied up the silica, but if there was an excess of silica, or of marble, it was best to be careful, because some of it might become airborne.

Introducing Conference Paper Authors

Mr. C. M. Stoch

Mr. C. M. Stoch, whose paper to the first BICTA Conference—and the discussion of it—occupies the preceding six pages, was born in Poland and obtained a university degree (Dipl. Ing.) in metallurgy in Krakow in 1937. Subsequently he was engaged in the steel-making department of the Baildon Steelworks, Katowice. In 1939 he was called to the forces and took part in the fighting in Poland, rejoining the Polish Forces in France in 1940 and subsequently in Great Britain. While still in the forces he had the opportunity of studying the steelfoundry industry in Great Britain, and in 1951 he joined the research and development division of the British Steel Founders' Association, now the British Steel Castings Research Association. He was engaged in the plant-engineering and dust-suppression section, and in 1953 he was made responsible for this section. By the end of 1958 he had become also acting head of the steel-making section. In 1956 he was elected a fellow of the Institution of Metallurgists.

Mr. J. E. Mitton

Another paper presented to the Investment Founders' Conference, that by Mr. J. E. Mitton, begins on the following page. Mr. Mitton was educated at Kilburn Grammar School, matriculating in 1946. He then joined the British Oxygen Company, Limited, as a junior chemist, being engaged on chemical and metallurgical analysis. He continued part-time evening study at Willesden Technical College and obtained Inter B.Sc. whilst employed with the British Oxygen Company, Limited. In March, 1950, he joined D. Napier & Son, Limited, as junior chemist in the investment-foundry laboratory, and continued part-time study at Acton Technical College. He was promoted to senior chemist in 1953, in charge of the investment-foundry laboratory, and also responsible for chemical control of investment-casting processes. Mr. Mitton obtained a B.Sc., special degree in chemistry in 1954 as an external student of London University. In 1955 he left his firm to do National Service in the RAF, rejoining Napier's in 1957 as chief chemist in the investment foundry. He is at present engaged on technical control and development work, mainly on the refractories side of the process.

Process Control in the Investment Shop*

By J. E. Mitton

The very nature of the various methods and techniques used in investment casting is such that some degree, usually a large degree, of technical control is essential for the smooth and efficient working of the process. Technical control includes, first, the work done by the laboratory in making sure that materials used in the process are up to standard and conform to laid-down requirements, and that conditions in the shops are correct, and, second, the work of the process-control department in seeing that the job is done in the right way.

Investment casting involves a very large number of variables, the control of which can become quite difficult. New ideas are continually being developed, tried and eventually incorporated into the process, together with new materials. A new casting may require only a slight modification of the routine method in order to achieve the best result, but this may give rise to a new defect.

First Principles

Small changes are easily forgotten, and so the first essential of technical control is the keeping of accurate records of all routine checks made by the laboratory, and of all experimental work done in production. These records should be made at the time of doing and not later from memory, which very often turns out to be guess-work. To control any one particular part of the process properly it is necessary to have an overall knowledge of all stages of the process, so that difficulties that may only affect the casting stage or even the cutting off of components may nevertheless be appreciated right at the start. When a new job is to be made or a new set-up is to be tried, the method of attack will have to be decided: Will it be better in an investment mould or in a shell mould? Which dipcoat will give the best surface finish? What about mould and casting temperatures? If we set it up this way, can it be cut off easily and without damage to the casting? These questions will have to be discussed and answered at the outset by those concerned, and by the persons who will have to control the process and see that the best results are obtained from each section.

Process-control Card

When such details have been decided on, and those concerned have a clear idea of any difficulties that are likely to occur, the relevant facts are best entered on a suitable process-control card, which should accompany the job on its journey through the system and be a clear set of instructions to the operators. Further facts may be added to this card where necessary. Then, in the event of any casting defect, the job of tracing where the fault occurred will be made easier, and a full record will be available for reference in the event of the job having to be repeated. Troubles frequently occur through an accumulation of small changes, which individually often go unnoticed until the percentage of scrap leads one to inspect part process-control cards. The reason for the trouble is then usually obvious.

Design Factors

This paper is concerned with technical control as applied in the investing shop; this is, from receipt of the wax cluster for dipcoating to the point at which the finished mould—be it invested or shelled or both—leaves the investing shop to be dewaxed prior to casting. The completed wax cluster will have been designed primarily with a view to obtaining a metallurgically sound casting, and secondly to provide a shape that can be handled and made into a shell or mould without too much trouble. Unfortunately, these two factors do not always go together, but much can usually be done to make the job of the investing shop easier. Complication of shapes seems to be continually increasing. cored sections get larger, and smaller in cross-section, and at first sight a job may seem to offer an almost impossible task in mould-making. Several methods may have to be tried, frequently combining two or more techniques; and in these cases it is essential that there should be close liaison between departments in the design of the set-up. It is not much good having a beautiful casting if it cannot be cut off the runner without damaging it! A mould is useless if the wax members are so close together that mechanical breakdown of the mould material will occur, giving rise to refractory inclusions in the casting.

Temperature and Humidity Control

In the investing room itself it is desirable to have some form of air conditioning, so that temperature and humidity can be kept to a reasonable level and as constant as possible. Because of the nature of the process the humidity will tend to be on the high side, but the temperature should be kept close

* Paper presented at the first annual conference of the British Investment Casters' Technical Association (held at Connaught Rooms, London, on May 11 and 12). The author is on the staff of D. Napier & Son, Limited.

to 68 deg. F., and a good circulation of air provided. A constant temperature is most important for the storage of dipcoated clusters, and to a lesser extent for the storage of invested moulds and shelled moulds. Quite a small variation in temperature is sufficient to crack and loosen dipcoat from the wax surface. This may not be immediately obvious, and indeed can often go undetected to cause a refractory inclusion, or a surface defect brought about by binder penetration between wax and dipcoat. It may also result in metal "finning" along the line of the crack. If any very fine flash is left on the wax the dipcoat will be prevented from forming a continuous covering layer, so providing a ready-made line of weakness for these types of defect. Should it be necessary to clean the wax in alcohol prior to dipping, local lowering of temperature due to evaporation of the alcohol can cause trouble if the wax is dipcoated too soon after treatment. Shell moulds should be kept at the constant temperature of the investing room right up to the time immediately before de-waxing, to prevent cracking. Thin and fragile cores are especially liable to fracture. The same applies, but in a lesser degree, to invested moulds. Here, drying proceeds at a very slow rate prior to dewaxing, and the mould is in a rubbery state and somewhat better able to take up any small variation in wax volume. Also, conduction of heat to the wax is slower, and it is usual for the investment to be encased in a can which adds to its strength.

Binder Life and Dipcoat Drying

Chemical reaction rates are dependent on temperature, a fact which influences the gellation time of binders. However, when compared with other factors such as the addition of accelerators, the normal variations of temperature experienced in the shop have a relatively small effect on the life of a binder. If the humidity of the shop is too high, drying rates of dipcoats will be considerably slowed down. This can cause trouble, especially on a repeated dipping process where it is advisable to have one coat dry before the next is applied. Some means of knowing when the dipcoat is dry is useful, and in certain cases it is possible to incorporate a dye into the dipcoat slurry that will show a pronounced fading of colour on drying. It is as well, then, to take periodic readings of temperature and humidity, and for this purpose a continually-recording instrument is preferable. Changes are easily seen from the inked chart, which is particularly desirable over shut-down periods, when conditions may alter considerably.

Control of Raw Materials

Storage of refractory materials can be quite a problem. The aim is to keep them as dry as possible before use, and so ensure efficient mixing when this is necessary. In a damp climate this is not easy, and is often made more difficult by the materials becoming wet during delivery. A large part of technical control of lost-wax casting processes comes in routine chemical and physical checks by the laboratory. In this way one can keep a check on the incoming new materials of the process, the various refractories, waxes, binder materials, etc., and ensure that the quality of the material does not alter, and that it will do the job one wants it to. Simple sieve-analyses and titrations are adequate for routine purposes, but more elaborate tests can be made at intervals if desired, if there are facilities for doing them.

Sieve Analyses, and Sedimentation Methods

Incoming refractory materials for investments and dipcoats are subjected to a sieve analysis, and the same is done for the final investment mix if mixing is done on the premises. Washing the material through the sieves with water gives more consistent results, and in the long run is quicker. Results can be filed away for future reference for as long as is necessary. Suitable limits should be fixed for the final grading, within which the mix is satisfactory for use, adjustments being made should the sieve analysis fall outside these limits. With fine powders, such as those used for dipcoats, a sieve analysis will not give an adequate indication of size distribution, and it is better to carry out a sub-sieve particle-size analysis by one of the sedimentation methods. The results should be plotted graphically for ease of comparison. By these means a check can be kept on the grading of consignments of new material. To relate the grading of particle sizes in a powder and the actual properties of the prepared dipcoat, is, however, a difficult matter, because the properties of the dipcoat probably depend more on the surface chemistry of the material.

Other Tests

Occasionally, checks may be made for permeability and crushing strength on prepared samples of investment. Results tend to be rather scattered, which is probably due to the difficulty of preparing a sample that is representative of actual conditions existing in the larger mould. There is normally no need for a routine chemical analysis of refractory materials to be made. If used investment is reclaimed for further use, the usual sieve analysis should be done after crushing and regrading. It is as well to keep an eye open for any build-up of alkalis derived from the use of sodium or potassium-silicate binders. Examination of mould material that has been reclaimed several times often shows that the particle shape has been considerably altered. Thus, the coarser fraction, instead of consisting of single particles of grog, will consist of smaller particles cemented together, and the particle shape, which may have been quite angular to start with, may become rounder in form and give rise to a weaker mould.

Binder Solutions

With a sodium-silicate investment binder, the usual titrations for acidity and alkalinity are made on the stock solutions and, after mixing, a sample is tested for acidity and adjusted to the desired value. The method of mixing of investment and dipcoat binders is important where there is a likelihood of gellation, such as in the case of a

sodium-silicate/nitric-acid binder. The working life of the binder will depend to a large extent on this, especially in the warmer months of the year, when the chances of premature gelling are considerably increased. Efficient stirring with slow addition of components is required, so that there will be no local concentration of acid over alkali or *vice versa*. Binder solutions are best stored at the temperature of the investment room. This is usually quite convenient for dipcoats, but may not be so for the larger quantities of investment-mould binders. In the summer months it may on occasion be useful to have a cooling system for the binder tank, or else the acidity of the binder can be adjusted to give greater stability of solution. Adjustments can also be made in the concentration of accelerator in the binder—it may have to be omitted altogether.

Dipcoat Procedure

Prepared dipcoats should be tested for viscosity. Methods may vary considerably, from timing the discharge of a known volume of dipcoat through an orifice (the flow-cup method), to a refined check with a torsion-wire viscometer. For each method, the procedure and test temperature must be exactly the same if results are to be at all comparable—they do not have to be in terms of absolute viscosity. However, such comparative results can only be obtained for the same type of dipcoat with the same refractory filler; with different fillers, for example, silica and zircon, it is possible to get the same value for viscosity, but the covering power of the dipcoat will be widely different. The bench life of dipcoats varies widely; but it is advisable in all cases to have constant stirring.

Defects in the Wax Set-up

Any defects in the wax set-up may result in a scrap casting, and operators should be trained to give each cluster a quick look over before dipping it in the slurry. Such procedure frequently discovers greasy waxes that may prevent a smooth continuous film of dipcoat forming (especially on sharp corners and welded joints), or little pieces of loose wax sticking to the cluster, in hollow sections, for example—these may be blown off with an air line. Small cavities sometimes appear in wax runners which, if not filled in, can give rise to weak slivers of dipcoat being left in the dewaxed cavity—these slivers will probably fracture a casting and result in a refractory inclusion. These things should all be noticed and put right by final inspection in the waxroom, but since they do escape notice on occasion it is wise to be on the look-out for them all the time. It is more usual now to dip the wax in the slurry rather than spray it on, mainly because of the difficulty of getting the spray into concealed areas. However, an airline can be of assistance in blowing dipcoat into sharp corners, and in eliminating air bubbles.

The Use of Zircon Sand to back the Dipcoat

When using zircon sand to back the dipcoat at the author's firm, it was found that if the sand was damp there was a tendency for a build-up of loose sand which could not easily be shaken off before the dipcoat was completely dry. Even then all was not removed by shaking, and it was necessary to give the cluster a light blast with an air line. If this loose sand was not removed before investing, or dipping again as the case might be, its failure to provide a good key for the secondary dipcoat or investment caused trouble. This trouble has been prevented now by the installation of a small electric-light bulb in the sanding cabinet. This keeps the sand quite dry but does not raise its temperature to any appreciable degree.

Investment Procedure

When it comes to investing the dipcoated cluster, the actual technique and procedure used will depend on its size and shape. The thickness or "pourability" of the slurry used will have been arrived at largely by past experience. It must be poured into the mould can smoothly—this is often done with the aid of some vibration. Filling of intricate parts is helped by melting the dipcoated surface just prior to investing. If one is using an investment with a range of particle sizes, too thin a slurry will cause excessive segregation of the particles, which may result in a weak mould. Such segregation may be overcome in some cases by the use of materials of differing densities. However, the slurry must be fluid enough to allow free escape of air bubbles. Complete displacement of air is not normally possible unless the slurry is subjected to a vacuum. If a large vibrating-table holding a number of moulds is used, the amplitude of vibration should be increased with loading to try to ensure an equal degree of vibration for each mould. The table should be given a periodic check-over to make sure that it is uniform in action, and that there are no dead points on it.

Mould Strength

The actual composition of the investment slurry as far as particle-size distribution and binder strength go will have been determined by the strength of mould needed, together with permeability requirements. The mould strength can be raised by increasing the percentage of fine material in the investment, with accompanying lowering of permeability, and by using a binder containing a greater percentage of bonding agent. Local strengthening of fragile parts may also be employed—by the use of vitrosil rod, for example. The strength of a multi-dipped shell mould will depend on much the same thing—strength of binder, the number of coats and the grading of the refractory used.

Gelling Agent

If a gelling agent is incorporated into the investment slurry to speed up the gel time, the percentage used should be determined by the laboratory from small-scale tests. It sometimes happens that a mould gels before it is completely packed. The reason will usually be either that some foreign material has got into the investment, or that the gelling agent has been added carelessly. If the gelling agent is incorporated in the investment dry-

mix, premature gelling may also be due to inefficient mixing. On the whole it is safer and more convenient to incorporate the gelling agent into the binder.

Mould Drying

Finally, the moulds have to be trimmed and given a period of drying at room temperature before being dewaxed. In the case of an investment mould made with a water-based binder the rate of drying at room temperature is extremely slow, and over a period of 24 hours is almost negligible, surrounded as it is on three sides by mould can and base plate. During this time, however, the gel throughout the mould is gaining in strength, except on the very surface, where most of the dehydration is occurring. It is important, therefore, to ensure that sufficient drying time or "hardening" time is given, so that the mould may better be able to withstand the pressures set-up by dewaxing. If for any reason it becomes necessary to store moulds in an unfixed condition for any length of time, it is best to stop dehydration by sealing them off from the air, or to incorporate into the mould material something that will prevent breakdown of mould-material bond due to "salting out" (this may happen with moulds made using an acid and inorganic-silicate binder). Needless to say, the temperature should be kept fairly constant during this period.

Acknowledgment

The author expresses his thanks to D. Napier & Son, Limited, for permission to present the information contained in this paper, and to colleagues for assistance rendered in its preparation.

DISCUSSION

The CHAIRMAN, Mr. W. Foyers, of H. & F. Precise Castings, Limited, called upon Mr. Mason to open the discussion.

MR. A. G. MASON (Deritend Precision Castings, Limited) began by saying that, as far as laboratory control was concerned, the tied foundries had an advantage over the independent operator, because they had large, usually well-equipped, and well-staffed laboratories. On the other hand, the independent organizations probably regarded the laboratory as an unwelcome growth in organization. To exercise the control which Mr. Mitton had outlined would mean a large increase in laboratory staff, and this would probably be unacceptable to the small, independent operator. Rapid standard tests were well established in conventional foundry work, and possibly the establishment of a committee of the British Investment Casters' Technical Association, to investigate the development of rapid standard tests, would be advisable.

MR. MITTON replied that to exercise the fullest possible control would not necessarily mean a large staff, but sufficient facilities would have to be available. Within the investment shop itself, one person could easily cope with process control. Laboratory staff did not have to be large, but it depended entirely on what other jobs a laboratory was doing. Rapid test methods for investment materials were desirable.

Different Method of Control

MR. R. TAYLOR (Firth-Vickers Stainless Steels, Limited) then said that he used a method which bore no relationship to the methods outlined by Mr. Mitton. He employed a common production-size mould, 12 in. high, 5 in. dia., with a slight taper. Mounted in that was a simple dummy wax assembly which was deliberately designed to represent the worst possible case. From a central sprue, he had little branches sticking out at right angles, or even at 45 deg., pointing downwards, to give the hardest possible test for the investment mix. The mould was invested in the normal way. The time taken to consolidate on a vibrating table was noted, as this was a valuable indication of packing behaviour. After the usual two-day drying, the mould was cut into two with a high-speed bandsaw and the halves then dewaxed and fired through the mould-firing furnace, then examined for texture. By poking it, he continued, he could see whether the mould was well packed in the difficult areas; whether it was firm, or whether it was so weak that it was not likely to stand up to metal wash. It was possible to see the thickness of fines-accumulation on the top of the mould, and, by the normal knock-out procedure, to find out whether the mould was too friable, or excessively strong. By slicing the mould down from top to bottom, the size, quantity and distribution of entrapped air bubbles, local "bridging" of coarse particles, if any, etc., became visible. Mr. Taylor concluded by saying that he considered this to be a very useful test, and maintained that it was better than any conventional laboratory test.

MR. MITTON agreed that cutting a mould provided much information, and said that his firm did that themselves, and often obtained useful information from sectioned block and shell moulds. They had had made half a mould, with one glass face, and had watched the reaction of the investment packed round a wax cluster. The trouble was that these difficult wax clusters often resembled the job his firm had to make.

Length of Storage Time

MR. H. J. MEERKAMP VAN EMBDEN (Philips Gloeilampenfabrieken) then said that his firm had obtained the impression that storing of moulds was detrimental for a binder. They worked them as quickly as possible, for the strength of the mould was apt to decline. He said that he had heard earlier on of the rubbery state of the mould, which was obtained in the fresh precipitate of the silica gel, and he thought the longer it stood the more it would deteriorate.

MR. MITTON replied that by long storage he meant two days at the most. His firm had found it necessary to store certain types of jobs for two days, particularly those with large curved surfaces. If they did not, they ran into trouble with rippled castings. This was probably due to a too-weak mould on de-waxing.

Cast-to-Shape Ingots for Copper-base Alloys

A number of years ago, for the research department of John Harper & Company, Limited, of Willenhall, a pattern was prepared for the production of ingots designed to fit loosely into crucibles used for experimental melts. The purpose was to secure rapid melting, and a maximum metal charge for each crucible. Now, *Centre Technique des Industries de la Fonderie* have developed and patented a similar system for use in copper-base alloy foundries. The following article is a translation of an article which appeared in the September issue of the *Journal d'Informations Techniques des Industries de la Fonderie:—*

Traditionally, ingots for remelting take the form of small blocks weighing about 20 lb. A simple calculation shows that the total surface area of a charge made up of such ingots is much greater than if the charge is concentrated in one simple mass. This is true for return scrap also, which is even more diverse in character than the ingots. The diversity of shape of the charge satisfied the old idea that it helped upkeep at a time when no real technical aids existed. However, the use of very diverse raw materials led to serious metal loss, directly proportional to the surface of the melting charge. The total surface area of traditional ingots making up a charge is three times greater than that of the metal charge itself, and that of the return scrap (runners, risers, etc.) is ten times greater. A shaped ingot (see Fig. 1), consisting of one metallic mass of the same contours as the inside of the crucible, will therefore bring about a distinct lowering of metal loss.

Advantages of the Shaped Ingot

The initial tests on the shaped ingot were carried out on a laboratory scale, and proved that the loss due to oxidation was reduced to less than half that experienced with normal charges. Since a one-per cent. metal loss raises melting costs by a farthing to a third of a penny per lb., the saving due to the use of shaped ingots is considerable. Naturally, in foundries where metal losses are low, the use of shaped ingots shows less spectacular economies.

Another advantage of the shaped ingot is its labour-saving potential, since stacking of the charge in the crucible, for example, becomes unnecessary. Furthermore, damage to crucibles from wedging of the traditional ingots is avoided. Melting practice is made easier, since less gassing is experienced. The process of reduction is carried out in what is virtually a closed area, and improved mechanical properties of the alloys used have been achieved.

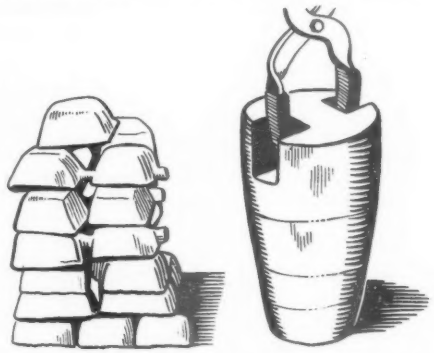


FIG. 1.—*Sketch showing the contrast between traditional ingots (left), and a cast-to-shape ingot.*

Research has also been done on preheating of shaped ingots, which is carried out by suspending them above a furnace and raising their temperature to 400 or 500 deg. C. In this way it has proved possible to reduce melting time by about 25 per cent., thus cutting down costs proportionately.

Book Review

Konstruieren und Giessen (Design and Casting), published, in German, by the Verein Deutscher Ingenieure and the Verein Deutscher Giessereifachleute, Giesserei-Verlag GmbH., Düsseldorf; price DM 18.50.

This book consists of two sections: the first (pp. 1-87) being a series of lectures which formed part of the proceedings of the 23rd International Foundry Congress, held in Düsseldorf in September 1956. The second section (pp. 92-155) is a well-illustrated report about the special exhibition "Design and Casting," which accompanied this educational lecture series, providing actual drawings, patterns and castings from practically all fields of modern foundry technique. A slightly abbreviated translation of the introductory lecture of this symposium: "Advantages of Cast Parts" by Prof. Dr.-Ing. W. Peppler appeared in the FOUNDRY TRADE JOURNAL, February 14, 1957, pp. 203-206. This introduction is followed in the book by a survey on "Recent developments of the casting materials and the possibilities of their treatment," all articles written by eminent experts in this particular field, *viz.*: (1) Cast Iron (by A. Wittmoser), (2) Cast Steel (by W. A. Stauffer), (3) Malleable Cast Iron (by K. Roesch), (4) Non-ferrous Metals (by W. Büchen) and (5) Recent developments of moulding and casting methods (by R. Schwalbe) (A translated abridged version of the article on "malleable cast iron" was published in the JOURNAL, April 24, 1958, pp. 479-83). The next paper: "Pressure Diecastings" (by F. Lutz) is a comparatively recent addition and was not read at the Congress.

The final chapter (by H. Herschenz) deals with the necessity for co-operation between designer and foundryman. It describes how the designer sets out his ideas on paper and how this initial stage is followed by a chain of experts in patternmaking, moulding, alloying, melting, casting and machining, all of whom contribute to the successful production of a finished article, *e.g.*, a cylinder-block of a motor car. However, in most cases it is clear there is no personal contact between these experts and the designer. These lectures in book form will serve a very useful purpose in helping all who aim at closer co-operation between those responsible for the inception of an idea in the initial design stage and those responsible for its execution—a responsible and often difficult task.

O. P. EINERL.

Prizegiving at Stanton

The 41st annual prizegiving of the Stanton Ironworks Company, Limited, was held on Saturday, November 21. Mr. J. K. N. Davis, chairman of the recruitment training and education committee of the Council of Ironfoundry Associations, presented the awards; Mr. N. C. Macdiarmid, managing director of the Stanton concern, presided and Mr. W. S. Matthews, training officer, gave his annual report. In this, Mr. Matthews said that the awards were being made for the work of the firm's students during the 1958/9 session, and 361 of them had qualified as recipients. This was 28 fewer than the previous year, mainly due to the reduced recruitment of apprentices at all four of the company's works. The total value of the awards to be made was £2,646, an increase of £48 compared with last year. Although he was not able to report a success at degree level, Mr. Matthews said he was pleased to announce the gaining of a diploma of the National Foundry College, by Mr. N. Gadsby, employed at the Holwell Works. The number of Higher National Certificates—four—was the same as last year, whilst the number of Ordinary National Certificates had increased from five to eight. Thirty-seven apprentices had gained City & Guilds national certificates, an increase of four over last year's total. Taking the four works of the company separately, 232 students had earned awards at the Stanton works; in the Holwell area, awards had been gained by 63 students from the Holwell works and by 14 apprentices employed at the local ironstone quarries of Stewarts and Lloyds Minerals, Limited. The Riddings works had the smallest group of students and of the 20 who had qualified for awards these included a first-class intermediate City & Guilds certificate in patternmaking, and three Ordinary National Certificates in mechanical engineering. At the Cochranes works, there was an increase of seven in the number of students gaining awards. Concluding his report, Mr. Matthews acknowledged the help and encouragement both he and the students had received during the year from a large number of people, including parents.

Special Awards

The "Scopes" Cup—awarded annually to the most proficient trade-apprentice completing his apprenticeship during the past year—was awarded to Mr. K. L. Bowley, who had completed his term as a moulder at the Stanton works. He had gained a second-class City & Guilds final certificate in foundry practice and had passed the first year of the Ordinary National Certificate in mechanical engineering.

The Joint Staff Committee Prize—awarded to the member of the clerical staff or technical staff showing the most progress during the previous session—went to Mr. J. R. Holt, of the slag laboratory at Holwell, who had gained a Higher National Certificate in metallurgy.

Cochranes' Joint Production Consultative & Advisory Committee prizes—awarded to apprentices making the most progress during the year—were presented to Mr. J. Gittus (apprentice patternmaker who had gained a final City & Guilds certificate in patternmaking), and to Mr. R. H. Robinson (apprentice fitter, who had gained an intermediate City & Guilds certificate in machine-shop engineering).

Cochranes' Foremen's Association Prize was awarded to Mr. J. P. Ibbotson, apprentice patternmaker, who had gained good marks in the first year of the City & Guilds patternmaking course, making 100 per cent. attendance.

Foster Prizes—awarded for outstanding progress in technical education—were presented to Mr. M. G. McGinley (apprentice draughtsman), and Mr. J. Langham (apprentice bricklayer).

Holwell Works Committee Prizes—awarded in the form of books to boys who had made good works' and educational progress—were presented to Mr. J. O. Parker (who had obtained a final City & Guilds certificate in plumbing and his registered plumber's certificate) and to Mr. P. N. Rackham (apprentice plumber who had gained high marks in the first year of the City & Guilds course on plumbing).

Holwell Foremen's Association Prize (consisting of tools to the value of approximately £2)—offered to the older apprentice with the best educational and works' record—was awarded to Mr. R. Garner (apprentice patternmaker, who had obtained a final City & Guilds certificate in patternmaking).

(*Concluded on page 566 at foot of col. one*)

Mr. J. K. N. Davis photographed with the recipients, after the presentation at Stanton on November 21. On the extreme left is Mr. A. Flowers, who received the Gold Award from the Duke of Edinburgh at Buckingham Palace on Nov. 3.

Latest Foundry Statistics

Iron Castings: An improvement in the production of iron castings is shown in figures recently released by the Iron and Steel Board for the third quarter of 1959. The Board states that production in this period was 802,180 tons, an increase of eight per cent. over the total for the quarter in 1958 (742,660 tons). In the first and second quarters of 1958, total output was 961,150 tons and 887,210 tons respectively, whilst in 1959 it was 828,100 tons and 878,590 tons. Details of production by district are shown in Table 1.

TABLE 1.—*Production of Iron Castings by District.*

District.	Third quarter. 1958.	Third quarter. 1959.
Northern	69,520	74,190
North West	81,140	78,310
Yorkshire	80,560	84,650
East Midlands	148,730	173,210
West Midlands	159,820	186,020
Eastern and Southern Counties	77,960	83,800
Scotland and Northern Ireland	69,890	72,030
Wales and Monmouthshire	55,040	49,970
Total	742,660	802,180

Following publication of the Iron and Steel Board's statement, the Joint Iron Council issued a detailed commentary on the figures as below:

As in many industries, output in the third quarter of the year is not comparable with that in any of the other three quarters because holidays are taken at this time. The effect of holidays on production varies, but over the past four calendar years—1955, 1956, 1957 and 1958—output in the third quarter has always been 98,000 tons or more lower than in the preceding second quarter. In contrast, this year the third quarter falls short of the second by only 76,000 tons, and this suggests very strongly that business improved for the industry in the third quarter of 1959 as compared with the second.

General

The figures for the third quarter of 1959 clearly show that the depression which developed in the second half of 1958 has been left behind. The industry, however, has still some way to go before the record outputs of 1955, 1956 and 1957 are reached. The progress made in the third quarter was more widely based than in the second, owing relatively less to the automobile section and more to other sections. Behind the improvement lies increased demand from several ironfounding customer industries whose fortunes have improved, and among these the steel industry, the building industry and public works are particularly noticeable.

Main Sections

A comparison of the output of iron castings in the third quarter of 1959 with output in the third quarter of 1958 is shown in Table 2. The statistics relate to both grey and malleable-iron castings and output is classified according to the main industrial groups purchasing or using the castings.

TABLE 2.—*Output of Iron Castings, by Section.*

Section.	Third quarter (thousand tons). 1958.	1959.	Percentage change.
Automobile (including tractors) ..	117.5	155.5	+32.3
Engineering*	257.9	256.8	− 0.4
Building and domestic	109.4	123.1	+12.5
Pressure pipes† and fittings ..	104.2	125.7	+20.6
Ingot moulds‡	77.3	91.4	+18.2
Railway equipment	76.4	49.7	−34.9
Total	742.7	802.2	+ 8.0

* Including machine tool, textile machinery, electrical, shipbuilding, etc. † Mainly gas and water. ‡ Mainly for the steel industry

The only section which has shown a significant reduction in output compared with 12 months ago is the railway-equipment section, and this in terms of tonnage produced is the smallest of the main conventional divisions into which total output is classified. However, the engineering section remains virtually unchanged and this is partly explained by the continued weakness in demand for castings for ships' engines, boilers and other items of heavy capital plant. The automobile and the building sections show marked improvement, while the output of pressure pipes and ingot moulds not only exceeded that of the third quarter last year but, despite the holiday influence, virtually equalled the output of the previous quarter.

Labour

The number employed in the ironfounding industry at the end of September 1959 was 125,000, and whilst this is 1,700 more than three months ago, it is still 3,200 fewer than at the end of September 1958.

Prizegiving at Stanton

(*Continued from previous page*)

Riddings Works Committee Prizes in the form of books were awarded to Mr. J. Bradley (apprentice turner, who had gained an Ordinary National Certificate in mechanical engineering) and to Mr. T. Weightman (apprentice patternmaker, who had gained an intermediate City & Guilds certificate in patternmaking).

Stanton Works' Committee Prize (consisting of tools) was presented to Mr. J. Chilton, apprentice boilersmith, who obtained high marks in the first year of the City & Guilds course in sheet-metal work.

Stanton Foremen's Association Prizes (in the form of books or tools) were awarded to Mr. R. Wheat (apprentice fitter); Mr. J. T. Turley (apprentice moulder) and to Mr. M. S. Pickering (apprentice joiner).

Earlier on the same day, at another ceremony, Mr. Davis also presented awards to 18 boys taking part in the Duke of Edinburgh's Award Scheme (see illustration on previous page).

Excessive Overtime Summons

Five AEU members who work at the Brightside Foundry, Sheffield, have been summoned to appear before the union's Sheffield District Committee on December 8, to face a charge of working excessive overtime. It is alleged by two shop stewards that the five men refused to carry out their instructions not to exceed the 30 hours-a-month overtime agreement between unions and employers.

At a mass meeting of workers held in the last week of November, the two stewards were ordered to apply for a suspension of the overtime limit at the works, and subsequently the District Committee lifted the restriction for three months. It is claimed that suspension of the restriction would have been justified before the application was made. The five workers concerned, claim that they exceeded the limit because they were engaged on special contract work and they took the view that management was entitled to ask for overtime when necessary to enable the firm to meet delivery dates.

Raw Material Markets

Iron and Steel

Business at the ironfoundries continues to expand and overall production of castings is increasing. This applies particularly to the engineering and speciality foundries, which continue to receive orders for appreciable tonnages of high-duty castings. While demand from some trades, including collieries and railways, is slow to recover its former level, the foundries supplying the motor vehicle trade are very busy.

The call for castings from the machine-tool industry continues to improve and many of the foundries catering principally for that trade are now better employed. The heavy engineering, power and electrical plant trades, steelworks, and others are using substantial tonnages of castings, which provide the foundries with sufficient work to enable them to obtain outputs at satisfactory levels.

For production of high-quality castings the pig-iron mainly used is in the low-phosphorus grades, averaging 0.2 per cent. phosphorus content, although fairly substantial tonnages of hematite are also utilized, together with some of the refined irons. With the recent increase in demand, the availability of some brands of the low-phosphorus irons is becoming more restricted and producers are finding it necessary to allocate supplies to the foundries to ensure fair distribution. Demand for hematite is also expanding and producers can now more easily dispose of outputs.

The improved call for high-phosphorus pig-iron indicates a continued increase in demand for castings for which this iron is required. Some of the engineering foundries using this grade are specifying more freely for supplies, and steady demands are made by the light and jobbing foundries. The supply position of the high-phosphorus pig-iron is comparatively easy and, apart from the requirements of the home foundries, makers are able to continue to undertake such overseas business as can be obtained. The increasing call from the steelworks for basic pig-iron is being met satisfactorily.

The scrap market is very active with an intensive demand for the better and heavier grades of cast-iron scrap. Foundry coke is being delivered in sufficient quantities, and ganister, limestone, and firebricks are readily available.

The re-rollers continue to be very busy and their main concern at present is to secure sufficient quantities of steel semis to undertake the work on hand. There is a strong demand for small bars and light sections, and the mills producing reinforcing rods are very busy. Full-time working at most of the re-rollers is assured for some time ahead, provided adequate quantities of billets, etc., can be obtained. Home steelworks are heavily committed for their outputs, which generally fall short of the re-rollers' present requirements for consumption and stock.

Non-ferrous Metals

Copper continues to be a hesitant market on both sides of the Atlantic. In London the central point to be faced is that cash copper is relatively scare and commands a material premium over three months' metal. Yet consumer buying is patchy, with the result that the undertone is still sensitive and more so to bad news than to bullish reports.

This situation appears to be common to the continental market centres, and all suffered last week, first by the lowering of the Belgian price, secondly by the small increase in LME stocks, and, finally, by the figures released in the United States concerning domestic consumption of copper in October. These figures showed that brass and wire mills and foundries —based on their shipments of fabricated products in October—consumed 100,302 tons, compared with 116,880 tons in September. New business was also down, 102,746 (131,687) tons. Moreover, stocks in the hands of fabricators at the end of October amounted to 431,612 tons, against 462,880 tons, with orders on hand with producers at 119,806 tons, compared with 116,675 tons in September. Nevertheless, the report that Japan is considering importing about 9,000 tons of electrolytic copper to relieve the shortage and also to curb domestic copper prices put the London market better.

The US position is much the same as before. None of the copper companies on strike have reached an agreement with the Mine, Mill and Smelters' Union. There is still no quotation for the custom smelters and the producers' price is unchanged at 33 cents a pound. The outlook is not clear. London is now waiting further developments from the United States and the same can be said about every other market centre, including New York.

Tin is moderately steady, with consumer interest sporadic. However, demand from the Continent has improved. It is difficult to know how much the present price level owes to activities by the buffer stock manager. Tin production in Malaya has increased perceptibly, the figure for October being 3,478 tons, which is 14.4 per cent. higher than that achieved in September. For the first 10 months of this year output amounted to 29,559 tons, a drop of only 13.7 per cent. on the corresponding period a year ago. Indications from Malaya, particularly the budget item for tin export duties next year which provides for the export of 60,000 tons, suggests that tin controls will be relaxed considerably next year. In the United States demand is still below par and the price is under $1.01 a pound.

Lead is little changed, with the price now struggling to keep above £70 a ton. Growing opposition to the US lead and zinc quotas is seen in a representation of six US companies to the US Tariff Commission to rescind quotas in favour of import duties. Lead is quiet in the United States and the price is unchanged at 13 cents a pound.

Zinc is a reasonably active market. Some observers feel that the recent shortage of metal has now come to an end. The Board of Trade is thought to have about 6,000 more tons to dispose on the market should that be necessary or desirable. Markets in any case are now running into the Christmas period and a slackening of activity is looked for. The US market seems to be waiting for the outcome of the present steel negotiations for an overall settlement before taking a strong line in the market. Meanwhile, the quotation is called 12½ cents a pound for East St. Louis spot.

Reorganization of a Fettling Shop. It is regretted that an error appeared in the article under this title appearing in the October 29 issue of the JOURNAL. On page 379, column one, line 24, the figure quoted for air consumption should have been 100 cub. ft. per min. instead of 1,000.

A ONE-TON PER HR. CUPOLA and a 400-lb. oil- or coke-fired crucible furnace are amongst the requirements listed for India. Details are available from the Board of Trade, Lacon House, Theobalds Road, London, W.C.1, quoting reference number ESB/28280/59.

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

December 2, 1959

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2, 10-ton lots or over: Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.40 per cent. P, 10-ton lots or over, £23 5s. 0d., delivered Birmingham, £23 10s. 0d., delivered Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 6s. 6d.; South Zone, £25 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.: North Zone, £26 6s. 6d.; South Zone, £26 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent., 10-ton lots or over: N.-E. of England (local iron), £24 14s. 0d.; Scotland (Scotch iron). Zone S.1, £25 0s. 6d.; Sheffield, £26 2s. 6d.; Birmingham, £26 9s. 0d.; Wales (Welsh iron), £24 14s. 0d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants,, and Leicestershire in 10-ton lots or over.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £40 0s. 0d. to £42 10s. 0d., scale 15s. 0d. per unit, lumpy; 75 per cent. Si, £54 0s. 0d. to £57 10s. 0d., scale 15s. 0d. per unit, lumpy.

Ferro-vanadium.—50/60 per cent., 22s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 10d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £287 0s. 0d.

Ferro-tungsten.—80/85 per cent., 11s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 14s. 7d. per lb. of W.

Ferro-chrome (6-ton lots and over, lumpy).—4/6 per cent. C, £77 0s. 0d. to £81 0s. 0d., basis 60 per cent. Cr, scale 26s. 0d. to 27s. 6d. per unit; over 6 per cent. C, £74 10s. 0d. to £77 10s. 0d., basis 60 per cent. Cr, scale 26s. 0d. to 27s. 6d. per unit; 2 per cent. C,* 1s. 7½d. to 1s. 10½d. per lb. Cr; 1 per cent, C,* 1s. 8d. to 1s. 11d. per lb. Cr; 0.15 per cent. C,* 1s. 9d. to 2s. 0d. per lb. Cr; 0.10 per cent. C,* 1s. 9½d. to 2s. 0½d. per lb. Cr; 0.06 per cent. C,* 1s. 9¾d. to 2s. 0¾d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 10d. per lb.

Metallic Manganese.—94/96 per cent., carbon-free, £245 0s. 0d.; 96/98 per cent., £275 0s. 0d.

Ferro-columbium.—65/67 per cent., Cb + Ta, 19s. 9d. per lb., Cb + Ta.

Ferro-manganese (Standard).—78 per cent., £63 10s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft u.t., 100 tons & over, £31 15s. 6d.; tested, 0.08 to 0.33 per cent. C, 6 to 35 tons, £33 15s. 6d.; hard (0.41 to 0.60 per cent. C), under 10 tons, £34 17s. 0d.; silico-manganese, under 10 tons, £43 16s. 6d.; free-cutting, under 10 tons, £36 14s. 6d. SIEMENS MARTIN ACID (under 10 tons): Up to 0.25 per cent. C, £41 1s. 0d.; silico-manganese, £44 4s. 0d.

Billets, Blooms, and Slabs for Forging and for Stamping (under 10 tons).—Basic, soft, up to 0.33 per cent. C, £38 10s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 12s. 6d.; acid, up to 0.25 per cent. C, £43 4s. 0d.

* Average 68–70 per cent.

FINISHED STEEL

Heavy Plates and Sections (under 10 tons).—Ship plates, (N.-E. Coast), £42 2s. 0d.; boiler plates (N.-E. Coast), £44 12s. 0d.; floor plates (N.-E. Coast), £43 11s. 0d.; angles (N.-E. Coast), £39 16s. 6d.; joists (N.-E. Coast), £39 12s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats 5 in. wide and under, untested soft basic, 50 tons and over, £39 1s. 0d.; under 10 tons to 4 tons, £40 18s. 0d.; under 4 tons to 2 tons, £41 3s. 0d.; hoop and strip, coils, 100 tons and over, £38 0s. 0d.; uncoated strip mill coils, hot rolled, under 3 mm. to 12g., 25 tons to under 50 tons, £43 16s. 0d.; black sheets (hand mill), 24g., 10 tons and over, £57 14s. 6d.; galvanized corrugated sheets, 24g., 10 tons and over, £68 5s. 0d.

Alloy Steel Bars.—1 in. dia. and up; Nickel, £68 10s. 0d.; nickel-chrome, £99 4s. 0d.; nickel-chrome-molybdenum, £111 17s. 0d., in lots of 5 tons to under 10 tons.

NON-FERROUS METALS

Copper.—Cash, £248 0s. 0d. to £248 10s. 0d.; three months, £237 15s. 0d. to £238 0s. 0d.; settlement, £248 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 4d. per lb.; rods, 258s. 0d. per cwt. basis; 20 s.w.g., 293s. 0d. per cwt.

Tin.—Cash, £794 0s. 0d. to £794 10s. 0d.; three months, £790 0s. 0d. to £791 0s. 0d.; settlement, £794 10s. 0d.

Lead (Refined Pig).—First half December, £72 5s. 0d. to £72 7s. 6d.; first half March, £72 5s. 0d. to £72 7s. 6d.

Zinc.—First half December, £95 5s. 0d. to £95 10s. 0d.; first half March, £90 5s. 0d. to £90 10s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £130 15s. 0d.; rolled zinc (boiler plates), all English destinations, £128 10s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £107 10s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 11½d. per lb.; sheets to 10 w.g., 209s. 9d. per cwt.; wire, 2s. 9½d.; rolled metal, 209s. 9d. per cwt.

Brass (Brazing).—BS1400, B3, £159; B6, £211.

Brass (High Tensile).—BS1400, HTB1, £193; HTB2, £208; HTB3, £222.

Gunmetal.—BS1400, LG2, £198; LG3, £207; G1, 1%, £263; G1, 1%, £252.

Phosphor Bronze.—BS1400, PB1 (AID released), £295; BS1400, 90/10/1, £282.

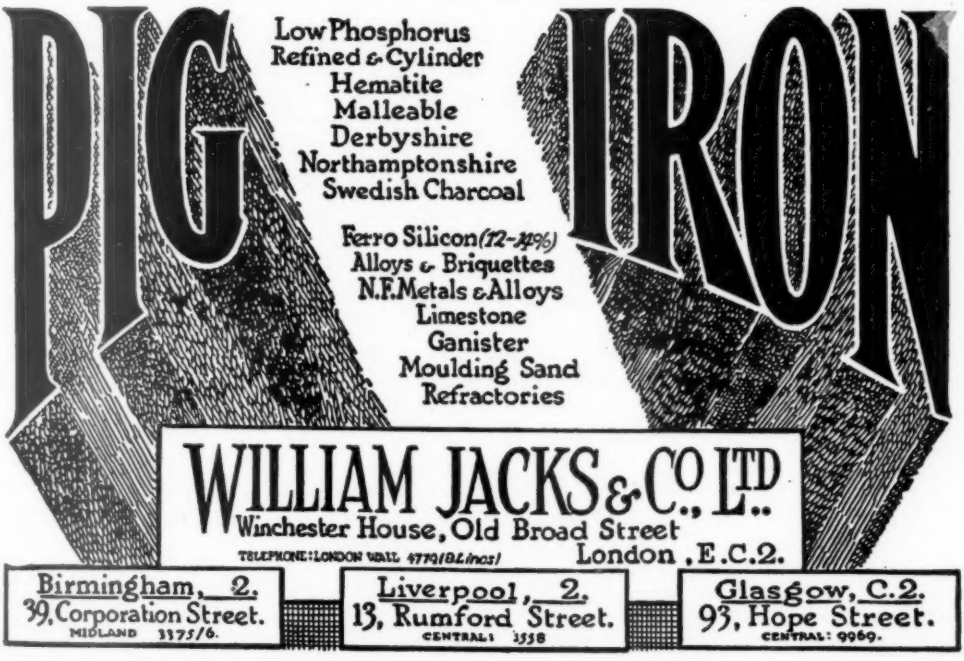
Leaded Phosphor Bronze.—BS1400, LPB1, £217.

Phosphor Bronze Strip, etc.—Strip, 294s. 9d. per cwt.; wire, 4s. 1⅝d. per lb.; rods, 3s. 4½d.; tubes, 3s. 4⅛d.; chill cast bars; solids 3s. 4¼d.; cored 3s. 5¼d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 10¼d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 3½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 2½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 0d. to 2s. 3d. per lb. Antimony, English, 99 per cent., £190 Cs. 0d. Quicksilver, ex-warehouse, £71 10s. 0d. to £72 0s. 0d. Nickel, £600 0s. 0d. Aluminium. ingots, £180 0s. 0d.; aluminium bronze (BS1400), AB1, £243; AB2, £253.

CHAL
mould drying
ovens give
minimum
processing time
with full
thermostatic control
CONTROLLED HEAT & AIR LTD.
Industrial ovens and dust collectors —
SMETHWICK · ENGLAND
5/31A/59


PIG IRON
Low Phosphorus
Refined & Cylinder
Hematite
Malleable
Derbyshire
Northamptonshire
Swedish Charcoal
Ferro Silicon (12-14%)
Alloys & Briquettes
N.F. Metals & Alloys
Limestone
Ganister
Moulding Sand
Refractories
WILLIAM JACKS & Co. LTD.
Winchester House, Old Broad Street
TELEPHONE: LONDON WALL 4771 (8 Lines)
London, E.C.2.
Birmingham, 2.
39, Corporation Street.
MIDLAND 3375/6.
Liverpool, 2.
13, Rumford Street.
CENTRAL: 3538
Glasgow, C.2.
93, Hope Street.
CENTRAL: 9969.

AEI Reorganization

Reorganization of Associated Electrical Industries, Limited, is virtually completed with the formation of five new product divisions. From January 1 the names of famous companies will be changed. The British Thomson-Houston Company, Limited, will be known as Associated Electrical Industries (Rugby), Limited, the Metropolitan-Vickers Electrical Company, Limited, will become Associated Electrical Industries (Manchester), Limited, and the new name for Siemens Edison Swan, Limited, will be Associated Electric Industries (Woolwich), Limited.

Five new product divisions of AEI are announced. The cable division and the construction division combine the interest of the cables division of Siemens Edison Swan with those of W. T. Henley's Telegraph Works Company, Limited, and Liverpool Electric Cables, Limited. The new telecommunications division has hitherto traded as a product division of Siemens Edison Swan. These three divisions, together with the radio and electronic components division, will be managed by Associated Electrical Industries (Woolwich), Limited.

The fifth division—the instrumentation division—combines the interests of Sunvic Control, Limited, with the instrument and meter, X-ray, and scientific apparatus departments of Metropolitan-Vickers and will be managed by Associated Electrical Industries (Manchester), Limited.

From January 1, therefore, the total of AEI product divisions to be established becomes 12. The famous companies whose names are to change will cease to trade, but will manage a number of AEI product divisions. Their employees will be transferred to AEI employment.

Birlec, Limited, the heat-treatment and furnace manufacturing company, will be renamed AEI-Birlec, Limited, and will be managed by Associated Electrical Industries (Rugby), Limited.

Referring to the changes at a London Press conference last week, Lord Chandos, the AEI chairman, said that the group hoped to gain economies from the reorganization because of longer runs of products and the transference of short runs to specialized plant. There would be little physical moving of plant or equipment from one area to another. The divisions would have the greatest degree of autonomy as was practicable to pursue a common policy, but all finance would, of course, continue to be run from the central headquarters of the AEI group.

Duties Reduced on Imported Machine Tools

Reduction of the import duty on machine tools from 17½ per cent. to 10 per cent. *ad valorem* was announced in the House of Commons on November 24 by Mr. Reginald Maudling, President of the Board of Trade. The reduction became effective on November 25. The system of refunding the duty in certain cases has been ended.

Hitherto, a user who had paid 17½ per cent. duty on an imported tool could get the duty remitted if he could establish that no comparable machine was obtainable from the domestic industry or that the delivery date was too long. Under this system, nearly all imported big machines were freed from duty.

The announcement has been welcomed by the Machine Tool Trades Association, which originally proposed the system now adopted by the Board of Trade.

Export Opportunities

The Export Services Branch of the Board of Trade, Lacon House, Theobalds Road, London, W.C.1, record that Mr. D. N. Macconel, the president of Machinery Sales Company (Inc.), 2838 Leonis Boulevard, Vernon, Los Angeles, has informed the British Consulate-General at Los Angeles that his firm would like to represent United Kingdom manufacturers of die-casting machines.

Firms interested in this enquiry should write by air mail direct to Mr. D. N. Macconel. It is important that any quotations should show f.o.b. and c.i.f. prices in US currency. It would be appreciated if responding firms would copy their initial correspondence to the British Consulate-General, 448 South Hill Street, Los Angeles 13, California, to enable the enquiry to be pursued.

It is also reported that tenders are invited by the Central Trust of China, purchasing department, 68, Yen Ping Nan Road, Taipei, Taiwan, Formosa, for the supply of a sand mill for mixing and kneading moulding sand; sand blender, capacity 175 cub. ft. per hr., 2 h.p. motor; mould-hardness tester; a permeability tester, scale 0-10,000; hand-operated sand rammer; sand bond tester, 1/20 h.p. motor; and a trolley ladle with lift capacity 90 kg. The project implementation order is No. 434-61-460-9-90121, and the invitation number US-588-1. United Kingdom firms who wish to tender should if possible obtain the necessary documents direct from the Central Trust of China. A copy of the specifications, etc., is available for inspection at Lacon House, Room 619, and photo-copy sets of the documents can be obtained at a cost of 4s. All quotations should be made in US dollars as quotations in sterling cannot be considered, and manufacturers should make a firm price quotation as bids quoting "prices ruling at time of delivery" are automatically disqualified. The closing date for the receipt of tenders is December 22. The BOT references numbers for these enquiries are ESB/27296/59 and ESB/27671/59/ICA respectively.

ECGD Cover for Confirming Houses

New policies covering confirming house business were introduced by the Export Credits Guarantee Department on December 1. The policies provide substantially the same cover as the present policies covering sales, but on renewal of a policy, the existing types of guarantee will cover only sales, and merchants will be required to cover confirming business under one of the new policies. No option will be created to cover only sales, or only confirming business, and merchants will (as hitherto) be required to cover both sides of their businesses for the same period and on the same basis—either both from date of contract or both from date of shipment. Until the renewal date of a one-year policy, or until the next "year-point" in a three-year policy, merchants' confirming business will continue to be covered by existing policies.

THIS YEAR the George Cohen 600 Group is 125 years old. Founded in 1834 by George Cohen, it was then a modest business in London for "the purchase and sale of scrap cast and wrought iron." To-day, the 600 Group serves the metallurgical and engineering industries of the world. Its turnover is some £30,000,000 a year; it has over 30 subsidiaries at home and overseas; and it employs assets of about £17,000,000.

Notes from the Branches

London

Mr. F. Hudson, F.I.M. (of the Mond Nickel Company, Limited), and Mr. E. C. Mantle, M.SC., F.I.M. (of British Non-Ferrous Metals Research Association), were the joint lecturers at the October meeting of the London branch of the Institute of British Foundrymen, held at the Constitutional Club, Northumberland Avenue, London, W.C.2. The meeting was well attended and members of the Association of Bronze and Brass Founders and the British Bronze and Brass Ingot Manufacturers' Association came along at the invitation of the branch. The evening's lecture was "Specification Requirements for Gunmetal Castings."*

The revision of specification B.S.1400 for copper-base castings has given rise to controversy, particularly between founders and ingot manufacturers, and this meeting was arranged to try and resolve some of the differences involved, keeping in mind the future requirements of the user of gunmetal castings. The speakers dealt with such matters as future outlook for gunmetal castings, specification details, testbars, properties of castings, inspection methods, and hall-marking of quality castings.

Before calling upon Mr. Hudson to give his contribution, Mr. D. A. C. Hutchison (senior vice-president of the branch who was deputizing for Mr. J. Bain, the president), gave a special welcome to Mr. J. Vanick, a celebrated non-ferrous metallurgist from the United States, and an officer and medal winner of the American Foundrymen's Society. He also voiced the branch's welcome to members of the ABBF and the BBBIMA who were present and asked them to participate freely in the proceedings.

Mr. Hudson then gave his contribution which was illustrated by slides. He pointed out the need for an all-out sales and propaganda effort for the increased sale of copper-base castings which, he said, was on the brink of a similar decline per head of population as in the USA. He then went on to detail the proposals for the changes to B.S.1400, mentioning the incorporation of nickel or the adoption of the British Non-Ferrous Metals Research Association's alloys to meet the new demands of industry. Mr. Hudson gave his own laboratory's results in modifying the composition of gunmetals of the 85/5/5/5 type.

Mr. Mantle's contribution was divided into three sections, *viz.* (*a*) alloys, (*b*) commercial gunmetal specifications, and (*c*) test-bars. When dealing with the properties of alloys, the speaker referred to graphs and text of a leaflet, prepared by the BNFMRA, and which had been circulated to members present at the meeting. He showed slides and described the alloy properties, *i.e.*, casting *versus* test-bar properties. He said that the BNF gunmetal, with a composition of Cu. 87½, Sn. 7½, Zn. 2, and Pb. 3 per cent. was considered better for use when producing castings with thick sections. He confirmed generally the statements made by Mr. Hudson regarding nickel-containing alloys, but said that sufficient work had not yet been done on this point. Dealing with commercial gunmetal specifications, he enumerated some founder/user reactions arising from their use. Regarding test-bars, Mr. Mantle said more guidance was needed and the test-bar type should be fully specified. The results of tests in member foundries were shown by slides.

This concluded the Authors' contributions and the meeting was then opened for discussion, members of the ABBF and BBBIMA joining in. (These proceedings will be reported later). Mr. A. R. French, in proposing the vote of thanks to the lecturers said there was a real need for improvements in non-ferrous alloys to meet the demand of industry. It had been shown that even small changes in alloy composition had a wide effect. Mr. W. R. Buxton seconded, and the meeting was then closed.

* Paper shortly to be printed in this JOURNAL.

East Anglian Section

On November 13, members and friends of the East Anglian section met again at the Oriental Café, Ipswich, for their annual dinner and social function. They were honoured by having Mr. J. Bain, the London branch president, together with Mr. A. R. Parkes, the secretary, as their guests. Mr. Bain responded to the toast "The Institute of British Foundrymen" coupled with the "London Branch" which was proposed by Mr. H. A. Wincer. The toast "The East Anglian Section" was most ably proposed by Dr. D. V. Atterton, of the Birmingham branch, the response being given by Mr. T. D. Oughton, section president. After dinner, light relaxation was provided by the Benny Lyon Show which certainly produced first-class entertainment. Mr. A. M. Whipp brought the evening to an official close by proposing a vote of thanks to Mr. V. W. Child, on whose shoulders fell the work of organizing the function, also to Mr. L. A. S. Harbourne (toastmaster) and to the artistes for their fine performance.

Speakers at the annual dinner of the IBF East Anglian section, held in Ipswich on November 13.

Left to right: Dr. D. V. Atterton, M.A., vice-chairman of the Institute's Technical Council; Mr. A. M. Whipp (section past-president); Mr. T. D. Oughton (section president); Mr. J. Bain, A.M.I.MECH.E. (London branch president), and Mr. H. A. Wincer (previously section secretary).

(*Courtesy, East Anglian Daily Times*

News in Brief

ACCORDING to the Barclays Bank D.C.O., *Overseas Review* for November, Automotive Products Company, Limited, are to establish a factory at Isando, east of Johannesburg, South Africa.

SIX MEMBERS of a productivity team from Japan visited the works of the Wolverhampton Die Casting Company, Limited, on November 23, and also the Birmingham factory of Fisher and Ludlow, Limited.

THE BOARD OF TRADE has issued a reminder that the Open General Licence permitting exports of specified types of iron and steel scrap expires on December 8, and states that this licence will not be re-issued.

ABOUT 1,000 EMPLOYEES of the Star Aluminium Company, Limited, Wolverhampton, are to work a shorter week from January 1, when hours will be reduced from 44 to 42 without loss of pay. The company manufactures aluminium foil.

THE LATE PROFESSOR F. C. LEA, who was head of the Department of Mechanical Engineering in Sheffield University from 1932 to 1936, is to be commemorated by naming the strength of materials laboratory in the Department, the F. C. Lea laboratory.

THE THREE BELLS in the tower of St. Mary's parish church, Stretton-cum-Wetmoor, Staffordshire, are to be dismantled, melted down and recast into a peal of six bells because they are too heavy to handle. An appeal for £980 to cover the cost of the work, has been made by the Vicar, the Rev. D. B. Laughton.

EXTENSIONS to the factory of British Acheson Electrodes, Limited, at Clay Wheels Lane, Middlewood, Sheffield, are alleged to be the cause of "smoke, fumes and noise" in a protest petition by local residents, sent to Sheffield Corporation, Wortley Rural Council and Mr. John Mendelson M.P. for Penistone.

THE MINT, BIRMINGHAM, LIMITED, is minting around 17,000,000 coins in readiness for Nigeria's Independence Day next October, this being part of the Royal Mint's order for over 1,000 million coins for Nigeria with a total face value of some £35,000,000. The Mint, Birmingham, is making 4,998,000 bronze pennies and 12,000,000 shilling pieces.

LEASONA HOLT, LIMITED, engineers, Rochdale, are to move to the premises of a cotton mill in Heywood, which is closing down. When the move is complete about 800 people will be employed instead of the present staff of 300. The firm, which has operated in Rochdale for over a century, was recently acquired by the Leasona Corporation, Limited, of America.

THE INDUSTRIAL TRAINING COUNCIL has approved grants to three industrial organizations to assist them to develop arrangements for training young people in their industries. The grants, the first to be made out of the Government's grant-in-aid of £75,000, announced last May, will go to the Cotton Board, the Booksellers' Association and to the Hotel and Catering Institute.

THE MIDLANDS, Cheshire, Lancashire, Yorkshire, the western counties, and Wales will be served by a new branch office opened at Lloyds Bank Chambers, 85, Regent Street, Leamington Spa (Warwickshire), by the Bedford mechanical, hydraulic, and electrical engineers, W. H. Allen, Sons & Company, Limited. Mr. J. C. C. Whyte, formerly technical representative for the west Midlands and mid-Wales areas, has been appointed manager of the new office.

WHEN THE 250,000TH VEHICLE came off the line on November 24 at the Rover Company, Solihull, Mr. G. Lloyd Dixon, executive director (sales) forecast a speed up in production of the Land Rover. He said that it had taken 11 years to reach the quarter-of-a-million figure, but present production rates indicated that the half-million stage would be reached in only another six years. Land Rovers had earned more than £87,000,000 in export markets.

PRODUCTION IN SOME SECTIONS OF MIDLAND INDUSTRY has increased rapidly in recent months and is beginning to outstrip the steel supply it was stated on November 17, at the Press conference following a meeting of the Midland Regional Board for Industry. Major C. R. Dibben, chairman of the Board, said that the upward trend was continuing. There was a shortage of labour in some cases and in others there was a shortage of raw materials especially sheet steel. Although October had been a record month for steel production, the Board had received several reports of production being held up because of sheet-steel shortage. The general atmosphere, however, was one of buoyancy.

THOS. FIRTH AND JOHN BROWN, LIMITED, Sheffield, are to provide a new shop for apprentice training which will increase the present capacity by 50 per cent. it was stated by Dr. C. Sykes, managing director, when presenting prizes to more than 100 apprentices at the works on November 20. Dr. Sykes went on to say that there would be excellent opportunities for fuel technologists in the future, the reason being that fuel costs were an increasing proportion of production expenses and this together with the implementing of the Clean Air Act would mean more highly-developed plant. Mr. G. May establishment and welfare officer, said that a special course was being introduced for those who wished to specialize in fuel technology.

ANY SETBACK in sales of British motor-cars to the United States and Canada would have "the most serious repercussion" in Britain, says Mr. A. B. Waring, chairman of Joseph Lucas (Industries), Limited, in his annual statement to shareholders. For that reason he adds, the high concentration of British car business in North America is "to some extent a cause for concern." The increase in British car sales to North America from 50,000 to more than 250,000 a year in five years, however, reflects the highest credit on British manufacturers. Mr. Waring says that there is every indication that the road vehicle industry will break all previous records in both the home and export markets in the coming year. He forecasts a decline in the aircraft industry and expects that the tendency for non-ferrous metals and other raw materials to rise in price may continue.

AT THE MEETING of the Birmingham Chamber of Commerce on November 23, the Road Traffic Section of the Chamber presented a report which urged that the Minister of Transport should give priority to the extension of the London-Birmingham motorway into Lancashire, with adequate connecting roads to the docks at Manchester, Liverpool and Birkenhead. The report stresses that quicker access to the ports from the Midlands is imperative if manufacturers are to secure more overseas trade. The problem of traffic congestion in the industrial Midlands is described as one of the most serious in the country. "It is obvious that the most urgent measures are needed to deal with the situation" the report says. The Road Traffic Section of the Birmingham Chamber also supports a proposal from the Wolverhampton Chamber of Commerce that large parking spaces should be provided near the London end of the M1 road. It suggests that car parks should be selected near stations on the Northern Line of the London Transport system giving access by rail to central London.

Fesil Silicon Briquettes

Fesil Silicon Briquettes are produced in Norway, the largest producing country of Ferro Silicon Alloys in Europe. Thus the Briquettes are manufactured right on the doorstep of raw material supplies required for such production.

Fesil Silicon Briquettes are produced by modern methods and under strict metallurgical control.

Fesil Silicon Briquettes are available for prompt delivery from stocks held in the United Kingdom.

Exclusive Agents and Distributors for the United Kingdom

F. & M. SUPPLIES LIMITED

4, BROAD STREET PLACE, LONDON, E.C.2. TELEPHONE: LONDON WALL 7222 (4 lines)
TELEGRAMS: FOUNDRIMET, TELEX, LONDON CABLES: FOUNDRIMET, LONDON.

FACTORY:
CONCORDIA WORKS,
LONDON, E.14.

FOUNDRIMET FOUNDRY & METALLURGICAL F.&M.S.LTD.

MANUFACTURERS OF MANGANESE, SILICO-MANGANESE AND OTHER FERRO ALLOY BRIQUETTES

Personal

Mr. J. LAUCHLAN who is managing director of Craven Brothers (Manchester), Limited, has been appointed chairman of the company.

Mr. H. MORLEY, general works manager of Samuel Fox & Company, Limited (a subsidiary of the United Steel Companies, Limited), has been appointed a director of the company.

Mr. J. E. ARMITAGE has been appointed commercial director of Vickers-Armstrongs (Aircraft), Limited, in succession to Mr. J. ANDERSON, who has retired on account of continued ill health.

Sir LESLIE ROWAN, finance director of Vickers, Limited, is to head a standing committee on policy towards under-developed countries set up by the Federation of British Industries.

Mr. ROLAND GIDLEY has been elected president of the British Association of Machine Tool Merchants in succession to Mr. SIDNEY PLASTOCK. Mr. W. E. NORTON was elected vice-president and Mr. E. J. F. BRADLEY was re-elected honorary treasurer.

Mr. E. O. PRICHARD has been made southern-regional manager and Mr. W. L. S. HATTON has been appointed senior representative in the same area for Foundry Services, Limited. Mr. Prichard has been in the south for five years, but Mr. Hatton is newly transferred from the Bristol area.

Mr. JOHN C. GEORGE, M.P., chairman of Joy-Sullivan, Limited, coal-mining machinery and compressed-air equipment manufacturers, has resigned from the board on his appointment as Parliamentary Secretary to the Ministry of Fuel and Power. Mr. George joined the board in 1950 and became chairman in 1952.

Mr. F. W. S. HEWITT, northern regional sales manager of Domestos, Limited, College Works, Albion Row, Newcastle-upon-Tyne, has been appointed southern regional sales manager of the Industrial division of the company. His former position is taken by Mr. J. SPENCE, Newcastle branch area manager. Mr. J. HARRISON succeeds Mr. Spence.

Mr. THOMAS GRAINGER, London manager of Ashmore, Benson, Pease & Company, manufacturers of gasworks and blast-furnace plant, etc., of Stockton-on-Tees, has received a presentation to mark his retirement. He joined the firm in 1907 as an office boy, leaving for seven years after the 1914-18 war. He later returned to work on gas-cleaning plant and joined the company's London staff in 1937.

For Sir CHARLES GOODEVE, F.R.S., a visit to Canada means a return to his native land, for he was born there in 1904. On Monday last he began a fortnight's visit to Canada and the United States. His busy programme includes a two-day symposium to be held by the General Motors Corporation on "The Theory of Traffic Flow." The application of operational research to street traffic is a subject that has long interested the director of the British Iron and Steel Research Association.

Among the 16 men who received long-service awards from Lord Riverdale, chairman and managing director of Arthur Balfour & Company, Limited, Sheffield steelmakers, recently, was his brother, the Hon. F. H. BALFOUR, a director of the firm. Longest serving employee is Mr. A. LINDSAY (68), one of the original crucible moulders, who has 40 years' service. Those with 35 years' service include Mr. Balfour, Mr. H. CRAPPER, manager of the production department, Mr. P. MCNAB, manager of the Birmingham branch office, and Mr. R. WHITEHEAD, tool division.

Obituary

Mr. JAMES SHEARER, head of the firm of Shearer Brothers, metal refiners, Glasgow, for over 60 years, has died at the age of 84. One of his sons is carrying on the family business, which has been established for over a century.

Mr. ALFRED ARCHIBALD FELLOWS, a well-known figure in the Midland iron and steel trade, has died at the age of 83. He had served on the boards of Lloyds Ironstone Company, the North Lincolnshire Iron Company; and the Islip Iron Company, and he was a partner in Lloyds and Company, iron merchants. Mr. Fellows was a founder member of the Central Pig Iron Producers' Association.

Mr. CYRIL ERNEST PROSSER, a former chairman of the Metals Division of Imperial Chemical Industries, Limited, has died at the age of 66. Mr. Prosser began his career with Elliotts Metal Company and when that company and British Copper Manufacturers, Limited, amalgamated with Kynochs, Limited, under ICI, he became assistant sales manager of the combined metals department. A delegate director in 1936, he later served as joint managing director and finally as chairman of the Metals Division until he retired in 1955 having completed 45 years with the group. During the last world war he was chairman of the Government-appointed panel to co-ordinate supplies of non-ferrous tubes and shell bands.

The sudden death took place on Saturday, November 28, of Mr. DENNIS SLEATH, Midlands-area manager of Borax Consolidated, Limited, a company he joined in 1936. For many years Mr. Sleath was honorary secretary of the Midland section of the Institute of Vitreous Enamellers, a position he still held at the time of his death.

Mr. A. C. LESTER, senior partner of Coldbath Foundry, Limited, non-ferrous founders, Islington, London (a company founded in 1920), died on November 29, at the age of 65. Mr. Lester had been an enthusiastic member of the London branch of the Institute of British Foundrymen since 1941.

"The Computer in Production"

To introduce chartered mechanical engineers and managers to the latest techniques involving the application of computers in production, and to provide a forum for managers, engineers, and users to present their views to manufacturers of computers, the Institution of Mechanical Engineers is arranging an informal discussion on "The Computer in Production" to take place at 1, Birdcage Walk, Westminster, London, S.W.1, from March 21 to 22, 1960. The meeting will commence each day at 10 a.m., continuing until 8 p.m. on the first day and to about 4 p.m. on the second day. Several distinguished engineers and users of computers will give talks on the subject, and visits to computer centres and to installations where computers are being used will also be included. The meeting, which will be open to members and visitors, is aimed primarily at management level, but the subject treatment is also likely to be of interest to specialists in computers. Those wishing to attend should apply to the secretary at the address quoted.

CAMMELL LAIRD & COMPANY, LIMITED—Admiral Sir Michael M. Denny, formerly CIC, Home Fleet, and CIC, Eastern Atlantic (NATO), has been appointed chairman in succession to Mr. J. C. Mather, who remains on the board. Mr. Mather, who has been chairman since 1951, expressed a wish to retire after his recent illness.

If you have a dust problem, we have an answer to it—an answer based on over 30 years' specialisation in industrial dust collection. During that time, we've settled pretty well every kind of industrial dust: metal, wood, plastic, food, chemical, and so on. We've done it with the help of up-to-the-minute scientific research and the widest range of equipment made in this country: filters, large and small unit collectors, wet collectors (particularly useful for fine or explosive dust), and complete plant installations. All our collectors are self-cleaning and are designed for either fully or semi-automatic operation.
See us for dust—and settle it once and for all.

DALLOW LAMBERT *dust control equipment for industry*

DALLOW LAMBERT & COMPANY LIMITED, THURMASTON, LEICESTER

CRC 88

Company News

DUPORT, LIMITED, ironfounders and engineers, etc., of Tipton (Staffs)—Final dividend for the year to July 31, 1959, is raised to 12½ (7½) per cent., making a total of 17½ (12½) per cent. Group profit expanded to £2,068,960 (£1,432,979).

POWER-GAS CORPORATION, LIMITED—The company has been holding discussions with Davy and United Engineering Company, Limited, regarding a possible association. Discussions are at an early stage and the outcome will be promptly announced.

SPERRYN & COMPANY, brassfounders and finishers, etc., of Birmingham—Group profits in the year ended July 31, 1959, amounted to £88,927 (£69,239) and the dividend is raised to 14 (12) per cent., with a final of 10 per cent. Net profit, after tax of £39,846 (£36,449), is £49,081 (£32,790).

CHARLES CHURCHILL & COMPANY, LIMITED, machine-tool makers, of Coventry—A notice has been received by the company of the intention to move a resolution at an extra-ordinary general meeting on December 8 recommending that Mr. G. E. K. Blythe be removed from his office as director.

NORTH CENTRAL WAGON & FINANCE COMPANY, LIMITED—Dividends are to be resumed with 4s. per £1 ordinary for the year ended September 30, 1959. After interest and tax the group net profit is £816,577 (£493,207 for the previous nine months). Exceptional credits of £95,837 (£21,455) raises the balance to £912,414 (£514,662).

TRIPLEX FOUNDRY, LIMITED—The company is commencing interim dividends with the payment of 5 per cent. for the year ending March 31, 1960. The 1958-59 dividend was 7½ per cent. Profits, before tax, are approximately £77,000 for the six months ended September 30, compared with £36,000 in the corresponding period of 1958.

JOHN HOLROYD & COMPANY, LIMITED, bronze founders, manufacturers of machine tools and gearing, etc., of Milrow, near Rochdale (Lancs)—Dividend is being raised from the equivalent of 7½ per cent. to 10 per cent. for the year to September 30, 1959. Group net profit is down to £347,542 (£357,322) after tax of £306,772 (£369,310).

SAUNDERS VALVE COMPANY, LIMITED—An increase to 7½ (4½) per cent. in the interim payment for the year ending March 31, 1960, is, state the directors, designed to reduce the disparity between payments and has no other significance. The total for 1958-59 was 17½ per cent. During the current year orders received and sales have been at a higher level than in 1958, the directors add.

BUTTERLEY COMPANY, LIMITED, bridge builders, structural and general engineers, etc., of Derby—A distribution of 3d. per 2s. 6d. share, not subject to tax, out of realized profits, payable December 12, is announced. A capital distribution of 4d. per share was made a year ago and in May it was stated that a further distribution was not recommended, but that the position would be reviewed in October.

BIRMINGHAM SMALL ARMS COMPANY, LIMITED—A difficult year was experienced in the steel division, states the chairman, Mr. J. Y. Sangster, profits falling to a low ebb, but the less favourable results were more than compensated by the improved results in other fields. Group trading profits expanded to £2,469,819 (£2,261,707) in the year ended July 31, 1959, and the dividend is raised to 12½ (11) per cent.

UNIVERSAL GRINDING WHEEL COMPANY, LIMITED—The dividend is effectively raised to 15 per cent., tax free (equivalent of 12½ per cent.), with a final of 10 per cent. for the year to September 26, 1959. Group trading profits amounted to £808,578, and after tax of £425,696, the balance is £426,889. These are the first group accounts. A year ago the parent company had a net profit of £366,841 after tax of £409,327.

HEENAN GROUP, LIMITED—Mr. C. L. Hill, the chairman, states that steps are being taken to acquire other engineering or allied businesses and so spread the group's interest in engineering. Negotiations are proceeding. During the second half of the year to August 29, 1959, the group experienced a marked recovery in orders, and the year ended with an order balance of £3,600,000, against the previous year's figure for the present group companies of £4,000,000.

STOTHERT & PITT, LIMITED, engineers and ironfounders, etc., of Bath (Somerset)—The chairman, Mr. R. A. Riddles, states that trading profits for the past year were satisfactory and completed sales reached a new record figure. All departments were fully employed in the year. The profit margin has fallen slightly and in the competitive trading conditions which now exist, Mr. Riddles feels that the way to improve profits in the future will be to increase turnover.

BAKER PERKINS, LIMITED, manufacturing engineers, of Peterborough—Negotiations are in an advanced state for the acquisition of the refrigeration, bulk-handling, and general-engineering side of the business of William Douglas & Sons, Limited, London, S.W.15. The assets used in the engineering activities of the present company will be transferred to a newly-formed subsidiary which Baker Perkins will acquire for £260,000 to be satisfied by the issue of the company's ordinary £1 units.

ROTARY HOES, LIMITED, Rotavator, tractor, trench-digger manufacturers, etc., of West Horndon (Essex)—A rights issue of 400,000 5s. shares at par on a one-for-nine basis to holders of November 23 is announced. The proceeds (about £97,000) will be used to buy plant and buildings necessary "to enable the company to increase production to meet the greater demand for Rotavators." The interim dividend is 5 per cent. (3d. per 5s. share) for 1959 and the final is expected to be 5 per cent. on the increased capital.

H. W. LINDOP & SONS, LIMITED, malleable ironfounders, of Walsall (Staffs)—There should be a marked improvement in the results for the year to next June if current conditions are maintained, said Col. C. A. B. Lindop, chairman and joint managing director, at the annual meeting. The current year had started well with all the company's factories working to capacity following the sudden recession in the industry in late 1958 and early 1959.

Directors of TUBE INVESTMENTS, LIMITED, state that the strong recovery experienced in all sections of the group's activities towards the end of the year to July 31, 1959, has been maintained and has since gained momentum. The decline in overall demand in the first quarter of the past year, referred to in last year's report, persisted into the spring of 1959 and was particularly severe in the steel tube division and involved a reduction in requirements from the iron and steel division. Group trading profits, after depreciation of £4,165,643 (£3,525,560), were £12,579,244. They include, however, the profits of the British Aluminium Company, Limited, for the seven months since acquisition and those of Reynolds-T.I. Aluminium, Limited, for a similar period following the purchase by Tube Investments of a controlling interest in this company. The directors point out that, in so far as they are comparable with last year, they indicate a reduction in earnings of approximately 10 per cent.